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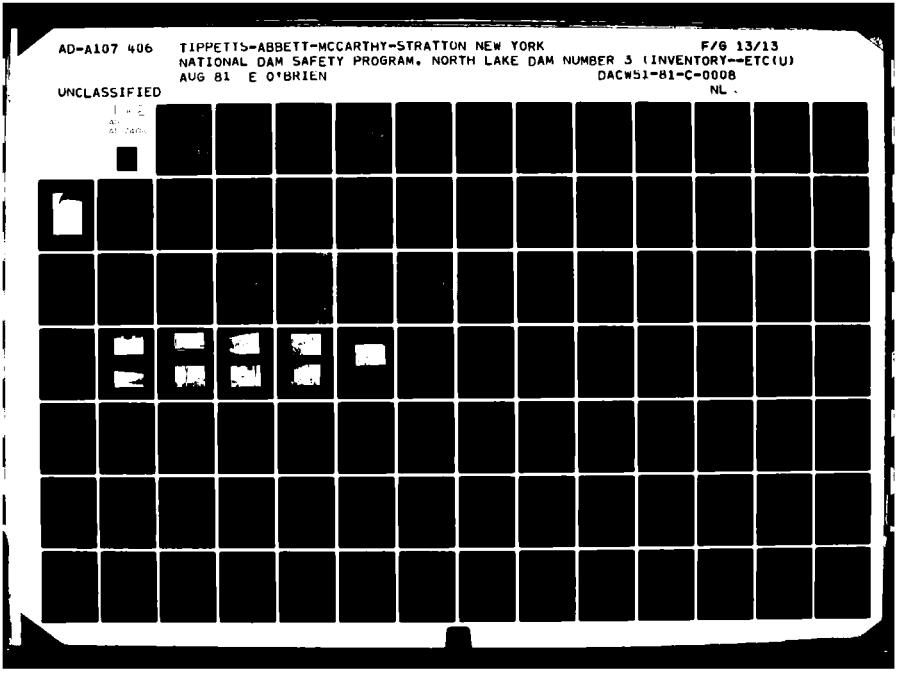

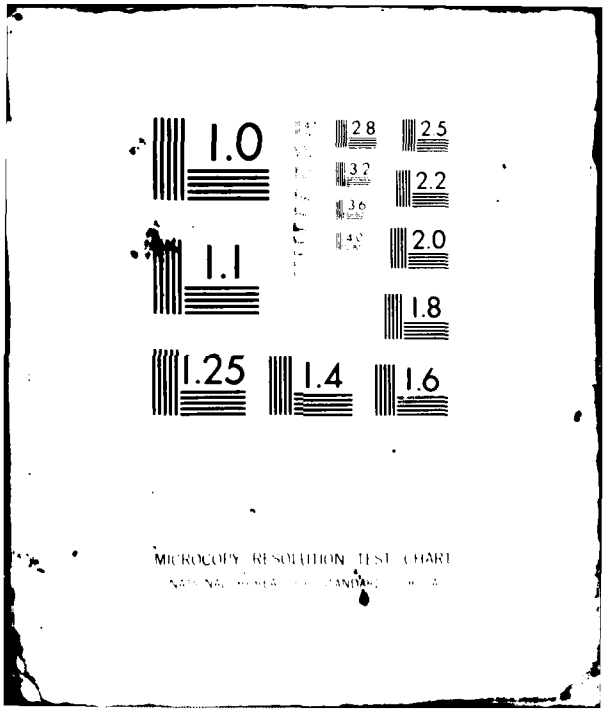
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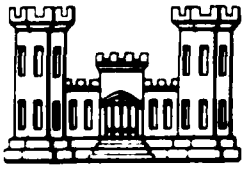
LEVEL II

LONG ISLAND BASIN

NORTH LAKE DAM NO. 3

WESTCHESTER COUNTY, NEW YORK
INVENTORY NO. N.Y. 113

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



NEW YORK DISTRICT CORPS OF ENGINEERS

SEPTEMBER 1981

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Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability
North Lake Dam No. 3
Westchester County
Long Island Basin

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Examination of available documents and a visual inspection of the dam and the appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property.

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Using Corps of Engineers' Screening Criteria, it has been determined that the dam would be overtopped for all storms exceeding approximately 21 percent of Probable Maximum Flood (PMF). The spillway is, therefore, adjudged as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

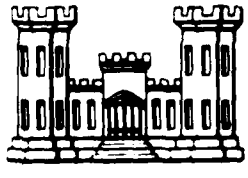
The classification of "unsafe" applied to a dam because of a "seriously inadequate spillway" is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping of the dam would take place, significantly impacting on dam stability and consequently increasing the hazard to loss of life downstream from the dam.

LONG ISLAND BASIN

NORTH LAKE DAM NO. 3

WESTCHESTER COUNTY, NEW YORK
INVENTORY NO. N.Y. 113

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



NEW YORK DISTRICT CORPS OF ENGINEERS

SEPTEMBER 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NORTH LAKE DAM NO. 3
I.D. NO. N.Y. 113
D.E.C. NO. 232-1093
LONG ISLAND BASIN
WESTCHESTER COUNTY, NEW YORK

CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NAME OF DAM:	North Lake Dam No. 3 (I.D.No. N.Y. 113)
STATE LOCATED:	New York
COUNTY LOCATED:	Westchester
STREAM:	Mianus River
BASIN:	Long Island Basin
DATE OF INSPECTION:	May 26, 1981

ASSESSMENT

Examination of available documents and a visual inspection of the dam and the appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property.

Using Corps of Engineers' Screening Criteria, it has been determined that the dam would be overtopped for all storms exceeding approximately 21 percent of Probable Maximum Flood (PMF). The spillway is, therefore, adjudged as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a "seriously inadequate spillway" is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping of the dam would take place, significantly impacting on dam stability and consequently increasing the hazard to loss of life downstream from the dam.

It is, therefore, recommended that within 3 months of notification to the owner, detailed hydrological/hydraulic investigations of the structure should be undetaken to more accurately determine the site specific characteristics of the watershed and their affect upon the overtopping potential of the dam. At the same time further analysis of the structural stability of the overflow and non-overflow section should be

performed. In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Also, around-the-clock surveillance of the structure must be provided during these periods.

Stability analyses performed, considering the dam acting as a gravity structure, indicate the maximum height non-overflow section of the dam to be insufficiently stable with regard to both overturning and sliding for the normal operating condition. Consequently it has been inferred that all other cases including ice loading, ½ PMF, PMF and earthquake loading will indicate similar unsatisfactory stability.

The structural stability of the dam, based on available information and visual inspection, when considered as a gravity structure appear contradictory. Based on the analyses, it would appear that a portion of the dam is performing as an arch. Available data to evaluate the structure as an arch dam, however, is insufficient to perform the required analysis. However, this data should be developed and additional stability analyses performed.

Of additional concern, is the presence of significant amounts of ponded surface water along the dam's toe. Portions of these water are assumed to be derived from collected surface water runoff, however, the presence of heavy marsh vegetation and "spongy footing" in sloping or otherwise, better drained areas along the dam's toe may be indicative of underseepage. Further evaluation of potential underseepage should be conducted.

The recommended seepage and stability evaluations should be initiated within 3 months of notification to the owner.

In addition, the dam has a number of problem areas which require further attention. The following remedial measures must be completed within one year:

- Removal of trash and debris from spillway channel
- Patch-up and Repair leaking cracks on the downstream dam face
- Repair or replace reservoir drain valve
- Remove vegetative growth on downstream face of dam
- Remove trees shrubs and other heavy vegetative growth immediately downstream of dam and fill and/or grade ground surface to direct surface water runoff away from the dam.

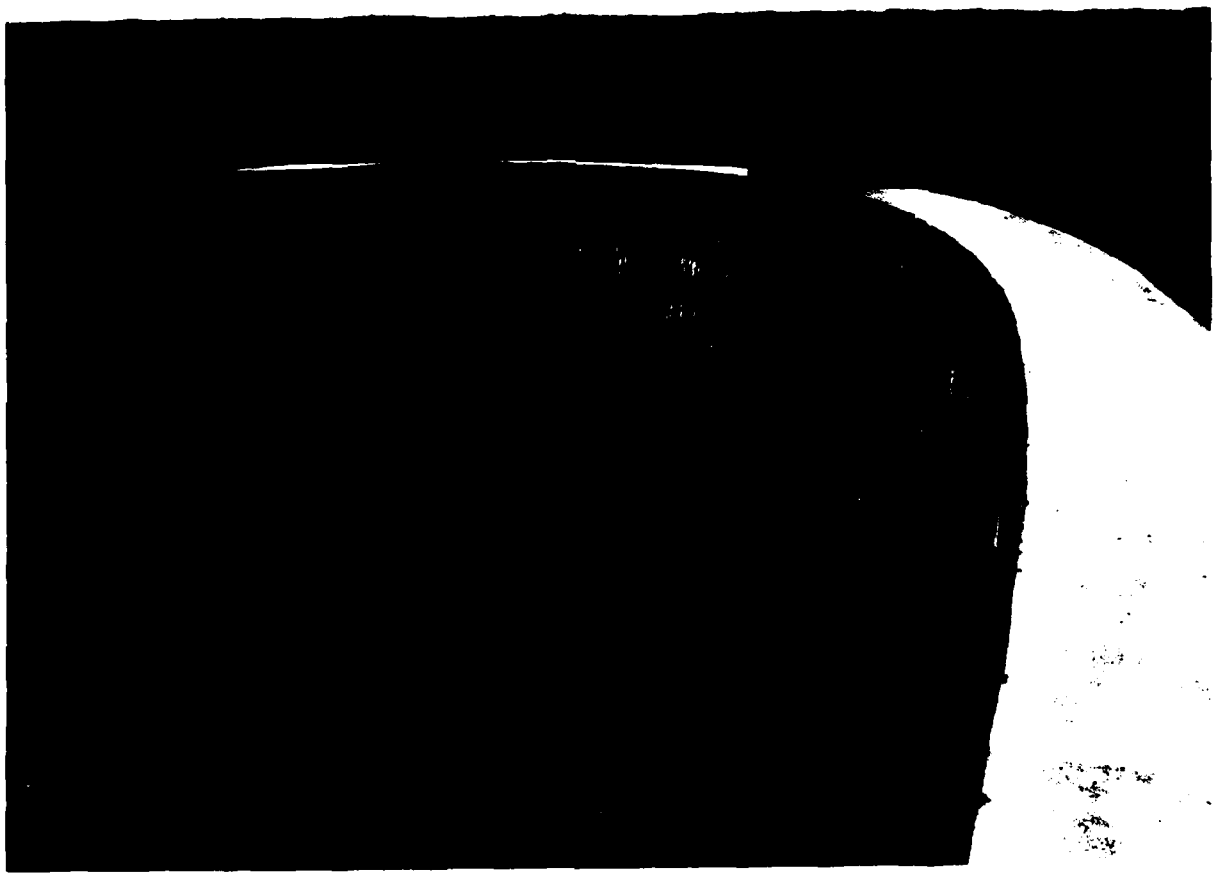
- Provide a program of periodic inspection and maintenance of the dam and appurtenances, including yearly operation and lubrication of the reservoir drain system. Document this information for future reference. The emergency action plan described in Section 7.1d should be maintained and updated periodically during the life of the structure.

Eugene O'Brien, P.E.
New York No. 29823

Approved By:

Col. W. M. Smith, Jr.
New York District Engineer

Date: 14 Aug 81



1. OVERVIEW OF DAM.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NORTH LAKE DAM NO. 3
I.D. NO. N.Y. 113
D.E.C. NO. 232-1093
LONG ISLAND BASIN
WESTCHESTER COUNTY, NEW YORK

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers Contract No. DACW 51-81-C-0008 in a letter dated 14 December 1981, in fulfillment of the requirements of the National Dam Inspection Act, Public Law 92-367, 8 August 1972.

b. Purpose of Inspection

This inspection was conducted to evaluate the existing conditions of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property, and to recommended remedial measures where required.

1.2 DESCRIPTION OF THE PROJECT

a. Description of the Dam and Appurtenant Structure

North Lake Dam No. 3 is a 600 ft long rubble masonry faced concrete and cyclopean masonry structure. Near the north and south extremes it performs as a gravity dam whereas the central portion of the structure is performing as an arch buttressed against two masonry and concrete abutments (See Appendix A). Maximum height of the arch section is 32 ft above the adjacent downstream "plaza". The back slope of the structures near vertical with the downstream face sloping at about 8V:1H. Crest width is typically 4 ft.

The service spillway (See Photographs 2 & 3) is a bi-level slot in the upper central portion of the crest having a maximum width of 17 ft for the 1.25 foot deep upper slot whereas the low level slot is 0.5 ft deep and only 3 ft wide. Overflow waters are collected in a 9 x 17 foot rectangular box structure (See Photograph 4) at the toe of the dam and discharged through a buried 4 x 4 foot reinforced concrete box culvert flowing eastward and discharging into Long Pond immediatelv east of Windmill Farms Road.

The dam is equipped with a reservoir drain system composed of an upstream inlet structure and 16 inches iron pipe (according to original design drawings). A gate valve located immediately downstream of the dam controls flow through the system. Waters are discharged into the spillway collection sump and passed through the previously mentioned 4 x 4 foot box culvert.

b. Location

North Lake Dam No. 3 is located in Westchester County on the Mianus River, immediately southeast of the intersection of Upland Lane and Windmill Road, approximately 2 miles northeast of The Town of Armonk, New York. The dam is in a moderately densely populated area known as Windmill Farms and directly upstream of Long Pond.

c. Size and Classification

The dam is 32 ft high and has a reservoir with a maximum storage capacity of 249 acre-feet and, therefore, is classified as a small dam.

d. Hazard Classification

The dam is in the "high" hazard potential category because of its close proximity (within 0.25 miles) to numous residences downstream and its location upstream of Lond Pond.

e. Ownership

North Lake Dam No. 3 is owned by the North Lake Association, Windmill Farms, Armonk, New York 10504, Tel.No.: (914) 273-3719. Operation and Maintenance of the facility is performed by the Dam Committee of the North Lake Association. Prime contact at the North Lake Association is Mr.Ernest Rudinger, President.

f. Purpose of Dam

The dam was constructed solely for the development of a lake to be used for recreation.

g. Design and Construction History

Preliminary design drawings for the dam were prepared by Elwyn E. Seelye & Company Consulting Engineers, 101 Park Avenue, New York, N.Y. in 1936. The dam was not built according to the design, however, and no as-built drawings or other construction documentation is known to exist. The dam was reportedly constructed in 1936.

h. Normal Operating Procedures

Water is released through an uncontrolled overflow at the center of the dam crest. The valve controlling the drain reportedly is in poor working condition and is not used to control the reservoir level.

1.3 PERTINENT DATA

a. Drainage Area	0.26 sq. miles
b. Discharge at Damsite	
Flood level at Damsite (Maxi.)	unknown
Reservoir Drain	inoperable
Principal Spillway	
Maximum Pool	70.0 cfs
c. Elevation (USGS)	
Top of Dam	573.75* feet
Maximum Pool	573.75* feet
Normal Pool	572.0 feet
Spillway	
Low Level Invert	572.0* feet
Flood Level Invert	572.5 feet
Reservoir Drain	
Upstream Invert	unknown*
Downstream Invert	533.75* feet
d. Reservoir	
Length of Normal Pool	0.36 miles
Length of Maximum Pool	0.36 miles
e. Storage	
Normal Pool	210 acre-feet
Maximum Pool	249 acre-feet
f. Dam	
Type	Masonry/Concrete Gravity w/Arch center Span
Length	600 ± feet

* Based on original design drawing data corrected to USGS Datum for Existing Pool Elevation.

Upstream Slope	Near Vertical
Downstream Slope	8V:1H
Crest Elevation	573.75 ft
Crest Width	4 feet
Grout Curtain	None

g. Spillway

Type	Bi-level broad crested overflow section of dam
Length	17 feet
Crest Elevation	
Low Level	572.0 feet
High Level	572.5 feet
Upstream Channel	None
Downstream Discharge	4' x 4 ' Box culvert from drop structure at toe of dam to open channel

h. Reservoir Drain and Pipeline

Upstream	unknown
Downstream	16 " cast iron pipe controlled by downstream gate valve discharge into 9 x 17 foot rectangular well at the downstream toe. Water is conveyed from the collection well via a 4 x 4 foot reinforced concrete buried box culvert exiting downstream of Windmill Road and flowing into the Miamus River Channel.

SECTION 2 - ENGINEERING DATA

2.1 GEOLOGY

North Lake Dam No. 3 is located in the New England Upland Section of the New England Maritime Physiographic province. The bedrock in this section consists of metamorphic, igneous and sedimentary rocks which have undergone a complex sequence of deposition, folding, faulting and erosion. In the vicinity of the damsite, bedrock is primarily composed of Fordham Gneiss.

2.2 SUBSURFACE INVESTIGATIONS

No data from subsurface exploration of the site are available.

2.3 DESIGN RECORDS

Available original design and composite interpretation of existing and as designed structure drawings are presented in Appendix A.

2.4 CONSTRUCTION RECORDS

Construction records for the dam are unavailable or non-existent.

2.5 OPERATION RECORDS

According to Mr. Ban Qamar, representative of North Lake Association, there are no records of operation.

2.6 EVALUATION OF DATA

The information obtained from the available documents and a visual inspection was considered adequate for the Phase I inspection and evaluation with the exception of detailed information to analyze stability of the central dam section as an arch.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The visual inspection of the North Lake Dam No. 3 was conducted on May 26, 1981. The weather was clear and warm with air temperature about 80°F. At the time of inspection the lake level was about 3-inches above the spillway low level invert.

b. Dam

The overall structural integrity of the dam is good with only minor spalling of the crest and upstream face and minor cracks within the downstream face being observed. The vertical and horizontal alignments of the dam show no signs of appreciable movements. However, the following adverse conditions were noted.

(1) There is minor seepage through small cracks in the masonry located at isolated areas along the entire dam (See Photographs 6 & 7).

(2) Vegetation is growing on the downstream face of the dam (See Photographs 7 & 8).

(3) The gate valve controlling the reservoir drain is not in good working condition and may not work at all.

c. Spillway

The spillway appears in good structural condition with the exception of minor spalling at the crest.

d. Downstream Spillway Channel

The spillway channel, located immediately downstream of the box culvert discharge pipe is blocked with trees, bushes and debris (See Photograph 5).

e. Reservoir Drain Channel

The reservoir drain uses the same box culvert discharge pipe as the spillway exiting into the spillway channel. The channel is blocked by trees, bushes and debris.

f. Abutments

The dam abutment areas are generally in good condition. Minor seepage from the abutment rock was observed near the south end of the dam.

g. Downstream Toe Area

The downstream toe area supports a lush vegetative growth consisting of a variety of deciduous trees, bushes, shrubs and reeds. Standing water is present at several localized topographic lows along the entire length of the dam. (See Photograph 10). Near surface soils in these low areas appear to be organic and are extremely wet and soft. Near surface soils along the dam toe in areas other than these lows are primarily sandy, moist to wet and "spongy", indicating the possible presence of seepage from beneath the dam.

h. Reservoir Area

No slides or general instabilities were observed along the reservoir shoreline in the general vicinity of the dam. No significant sedimentation was observed along the dam. The reservoir was free of floating debris and trash.

3.2 EVALUATION OF OBSERVATIONS

Although deficiencies were observed, there is no indication that the dam is in imminent danger. Some of the deficiencies noted previously are minor and should be corrected in conjunction with routine maintenance. Other conditions which may present potential for further deterioration or which require further data for evaluation need further investigation and/or repair.

The following is a summary of the problem areas encountered and recommended correction measures or further study requiring immediate attention:

1. Investigate the source of ponded water present at the toe of the dam.
2. Remove vegetative growth from downstream dam's face.
3. Debris and logs present in spillway channel should be removed.
4. The reservoir drain gate valve should be repaired to a good working condition or suitably replaced.
5. A program of periodic inspection and maintenance of the reservoir drain and its control facilities should be developed and implemented. This information should be documented for future reference. An emergency action plan should be developed.

SECTION 4 - OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

No written operation and maintenance procedures exist for the project. The normal operation is to allow flow through the service spillway.

4.2 MAINTENANCE OF DAM

It is reported that no routine maintenance of the dam is performed.

4.3 WARNING SYSTEM IN EFFECT

No warning system is in effect or in preparation.

4.4 EVALUATION

The overall operation and maintenance of the North Lake Dam is considered inadequate as a result of the following conditions:

1. Poorly operating or possibly inoperable reservoir drain valve
2. Vegetative growth on the downstream face
3. Numerous cracks and seepage in the face of the structure
4. Absence of a written operation and maintenance procedure
5. Absence of any written maintenance history

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 DRAINAGE AREA CHARACTERISTICS

The North Lake Dam is located in North Castle Township, Westchester County, New York (Hydrologic Unit Code No. 01100006), immediately southeast of the intersection of Upland Lane and Windmill Road, about 2 miles northeast of the Town of Armonk, New York. The basin, which is roughly rectangular in shape rises from a lake elevation of 572 to over 700 ft mean sea level. The lake occupies 12.8% of the 0.26 square mile drainage area, with moderately steep wooded slopes and narrow valleys.

5.2 ANALYSIS CRITERIA

Spillway capacity adequacy was analysed by developing a design flood, using the unit hydrograph method and the Probable Maximum Precipitation (PMP). The all seasons 200 square mile 24 hours PMP for the North Lake area, taken from Weather Bureau sources (Ref. 1), is 22 inches. The unit hydrograph was computed by the Snyder method using coefficient of 2 and 0.625 for C_T and C_p, respectively. The inflow hydrograph was developed by the U.S. Army Corps of Engineers HEC-1DB computer program (Ref. 2). Loss rates of 1.0 inch initial loss and 0.1 inch/hour constant loss were estimated as being representative of the basin for the design storm.

In accordance with the recommended guidelines for Safety Inspection of Dams (Ref. 3), the adequacy of the spillway was analyzed using the Probable Maximum Flood (PMF). A multi-plan analysis was performed for the full, 0.75, 0.50 and 0.25 PMF.

5.3 SPILLWAY CAPACITY

The ungated bi-level concrete spillway, with a crest elevation of 572 ft (MSL) is 17.0 ft in length with a maximum depth of 1.75 ft. The computed maximum discharge with the water surface at elevation 573.75 (top of dam) is 70.4 cfs.

5.4 RESERVOIR CAPACITY

The normal reservoir capacity is listed as 210 acre-feet. The computed surcharge storage of 39 acre-feet is equivalent to approximately 2.8 inches of runoff over the entire basin.

5.5 FLOODS OF RECORDS

There are no records available of floods or maximum lake elevation.

5.6 OVERTOPPING POTENTIAL

The potential of the dam being overtopped was investigated on the basis of the spillway discharge capacity and the available surcharge storage to meet the selected design flood inflows.

The analysis was performed assuming that the water surface in the reservoir was at spillway crest elevation at the start of the flood event. The computed PMF inflow peak was 922 cfs. The HEC-1DB analysis indicated that the dam will be overtopped by floods exceeding 21 percent of the PMF. Following is a summary of the computer analysis.

RATIO OF PMF	PEAK INFLOW (cfs)	PEAK OUTFLOW (cfs)	DEPTH OVER DAM (feet)
1.00	922	923	.62
0.75	692	690	.50
0.50	461	456	.36
0.25	231	143	.11

5.7 EVALUATION

The dam does not have sufficient spillway capacity to pass either the PMF or one-half (½) PMF without overtopping of the dam. The overtopping of the dam could cause the failure of the dam, thus significantly increasing the hazard for the loss of life downstream. The spillway is, therefore, assessed as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Visual observations did not reveal any conditions which at present adversely affect the structural stability of the dam. Seepage observed at the south abutment is exiting from fractures within the foundation rock and not at the interface and therefore is not considered an immediate hazard. The true source and nature of surface waters at the toe of the dam need further study.

b. Design and Construction Drawings

Original design drawings do not conform to the structure as it stands today. No construction drawings or record of construction are available.

c. Operating Records

There are no operating records for the dam. However, a series of correspondence included as Appendix E provide a partial record of past inspection and evaluation of the structure. Of particular note is a letter dated April 17, 1964, prepared by Mr. Ralph L. McDonald addressing dam cracks, seepage and stability of the dam performing as an arch.

d. Post-Construction Changes

There are no reported post-construction changes to the dam. Some repair work to patch-up minor cracks on both the upstream and downstream faces of the dam was reportedly performed in 1968 (See Corps of Engineers letter dated May 1978).

e. Seismicity Stability

The dam is located in Seismic Zone 1 and in accordance with recommended Phase I guidelines. However, based on the past earthquake activity in the area, the New York State Geological Survey considers the area to be more characteristics of a Zone 2 setting. Based on this assessment the dam is considered in the Seismic Zone 2.

SECTION 7 - ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety

Examination of the available documents and a visual inspection of the dam and the appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which require further investigation and remedial action.

Using the Corps of Engineers' Screening Criteria for review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 21 percent of the Probable Maximum Flood (PMF). The overtopping of the dam could significantly impact on the stability of the dam, thus increasing the hazard to loss of life downstream. The spillway is, therefore, adjudged as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a "seriously inadequate" spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping of the dam would take place, potentially reducing dam stability such that it would significantly increase the hazard to loss of life downstream from the dam.

The structural stability of the dam, based on available information and visual inspection, when considered as a gravity structure appear contradictory. Analysis indicate instability whereas performance indicates otherwise. Based on the analyses it would appear that a portion of the dam is performing as an arch. However, data available to evaluate the structure as an arch dam is insufficient to perform the required analysis. Further cause for concern is the stability of the downstream area with respect to developing a condition of liquefaction (zero effective stress) as a result of high seepage gradients. The extremely wet and spongy nature of the near surface soils at the toe of the dam throughout a majority of its length can be indicative of seepage either from beneath or through the dam. Preliminary analyses performed to assess seepage passing beneath the dam and exiting at the toe indicates a factor of safety with regard to critical exit gradients ranging between 1.65 and 2.21. If seepage were not passing below the dam but through cracks above the base considerably lower factors of safety would result. Further information regarding the geohydrologic conditions at the toe of the dam are required to further evaluate seepage stability.

b. Adequacy of Information

The information and data available were generally adequate for performance of this investigation with the exception of sufficient structural detail to permit performing stability analysis as an arch dam.

c. Need for Additional Investigations

A detailed hydrological/hydraulic investigation of the structure should be undertaken to more accurately determine the site specific characteristics of the watershed.

Development of detailed information regarding the construction of the dam is necessary to permit stability analysis of the arch section. Details pertaining to structural geometry, material properties of both the dam and foundation soils and details of structural connections and reinforcement within the dam are required to complete the analysis.

A detailed investigation to determine source of ponded surface waters at the toe of the dam and their potential indication of underseepage should be undertaken to provide data for more detailed seepage analyses.

d. Urgency

The additional investigations which are required must be initiated within 3 months from the date of notification. Within 12 months of notification, remedial measures as a result of these investigations must be initiated, with completion of these measures during the following year. In the interim, develop an emergency action plan for the notification of downstream residents and proper around-the-clock surveillance of the dam during periods of extreme runoff. The other problem areas listed below must be corrected within one year from notification.

7.2 RECOMMENDED MEASURES

1. The results of the aforementioned investigation and analyses will determine the appropriate remedial measures required regarding spillway modification, dam stability and seepage considerations.
2. Repair or replace low level outlet gate valve to a good working condition.

3. Remove debris and logs from spillway discharge channel.

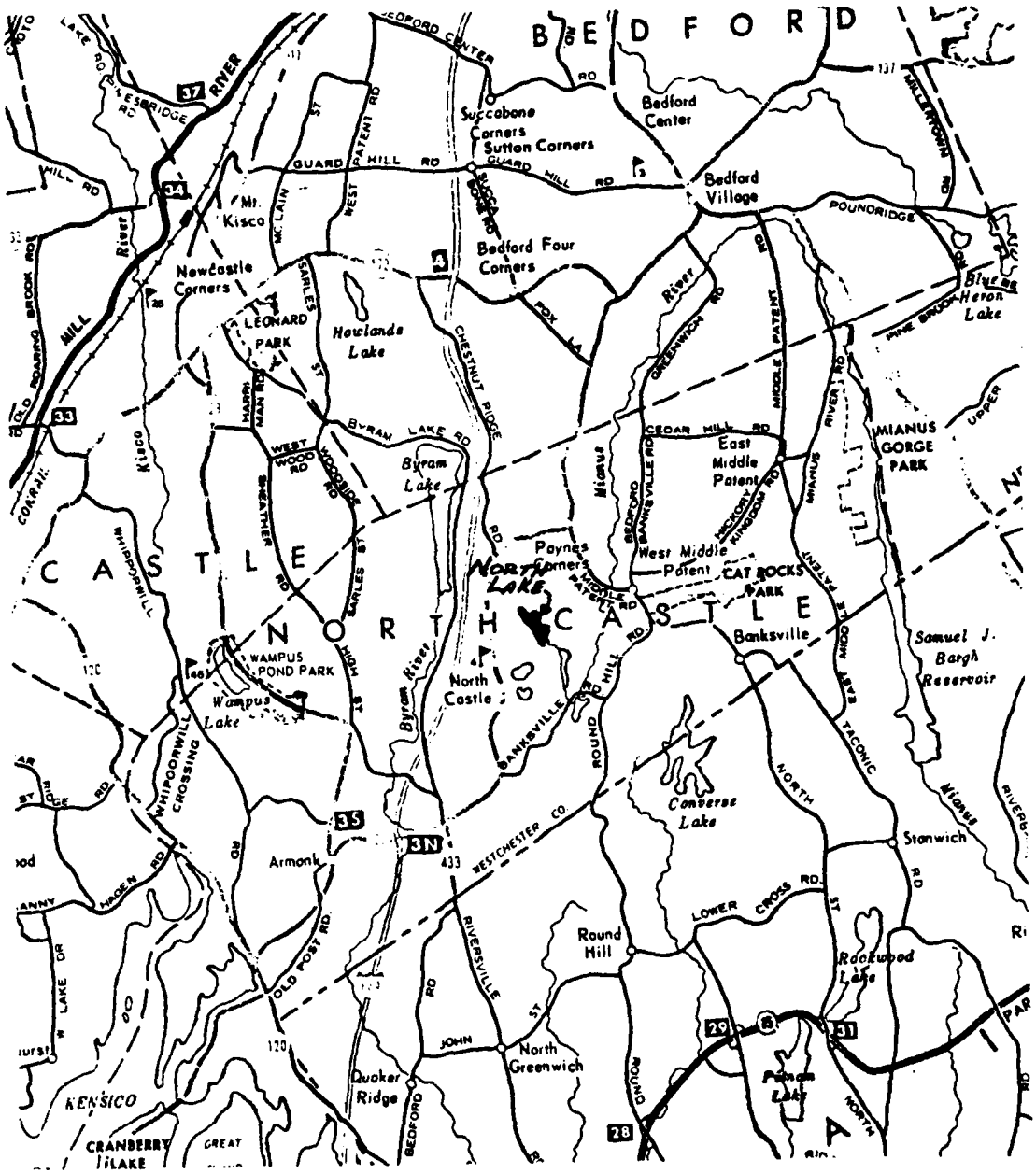
4. Patch-up and/or repair spalled concrete at crest and minor leaks on the downstream face.

5. Remove all vegetative growth from downstream face.

6. Provide a program of periodic inspection and maintenance of the dam and appurtenance including yearly operation and lubrication of the reservoir drain and its control facilities. Document this information for future reference. Establish an emergency action plan and maintain and update it periodically during the life of the structure.

DRAWINGS

APPENDIX A



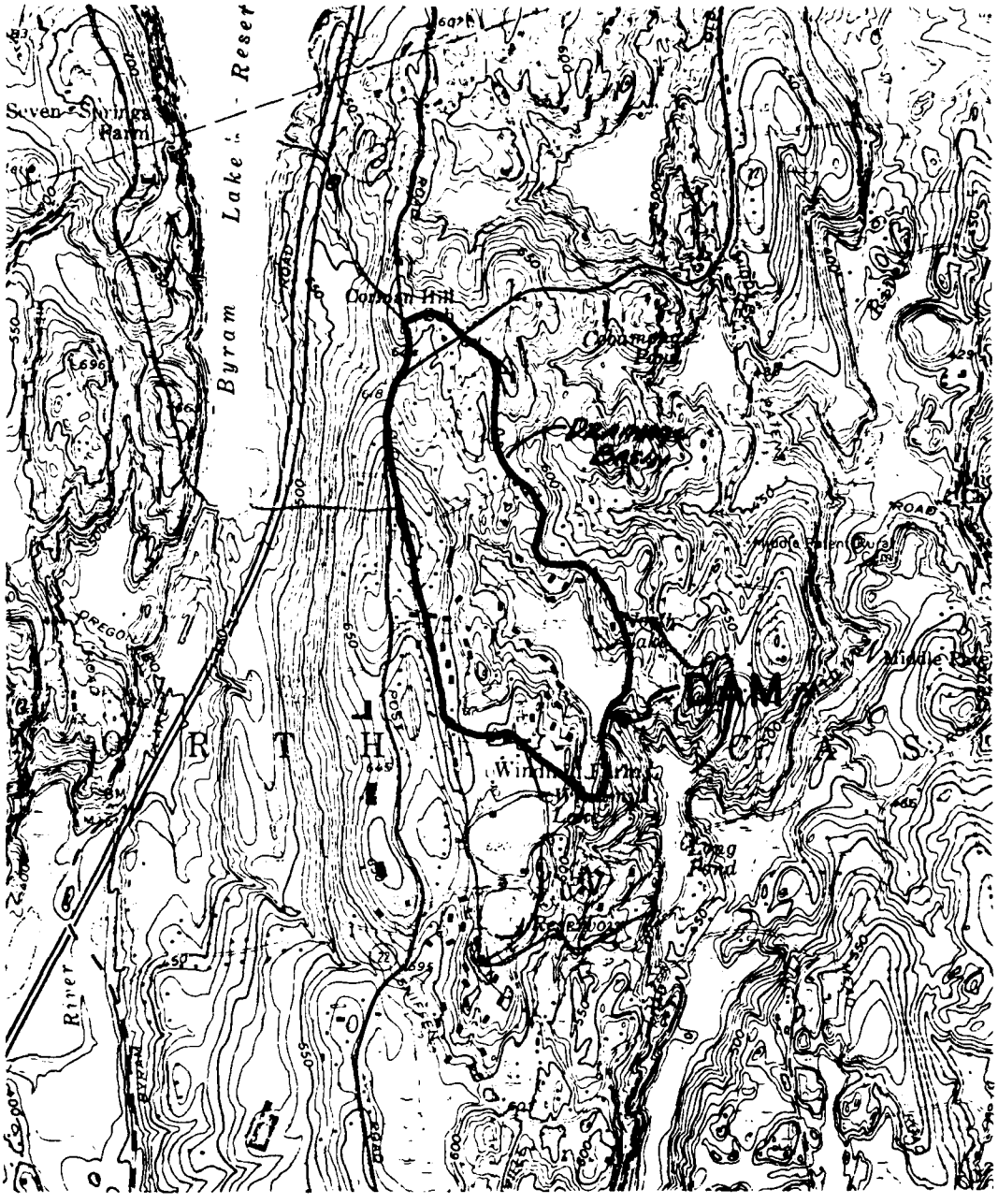
SCALE

0 1 2 3 4 Miles

VICINITY MAP

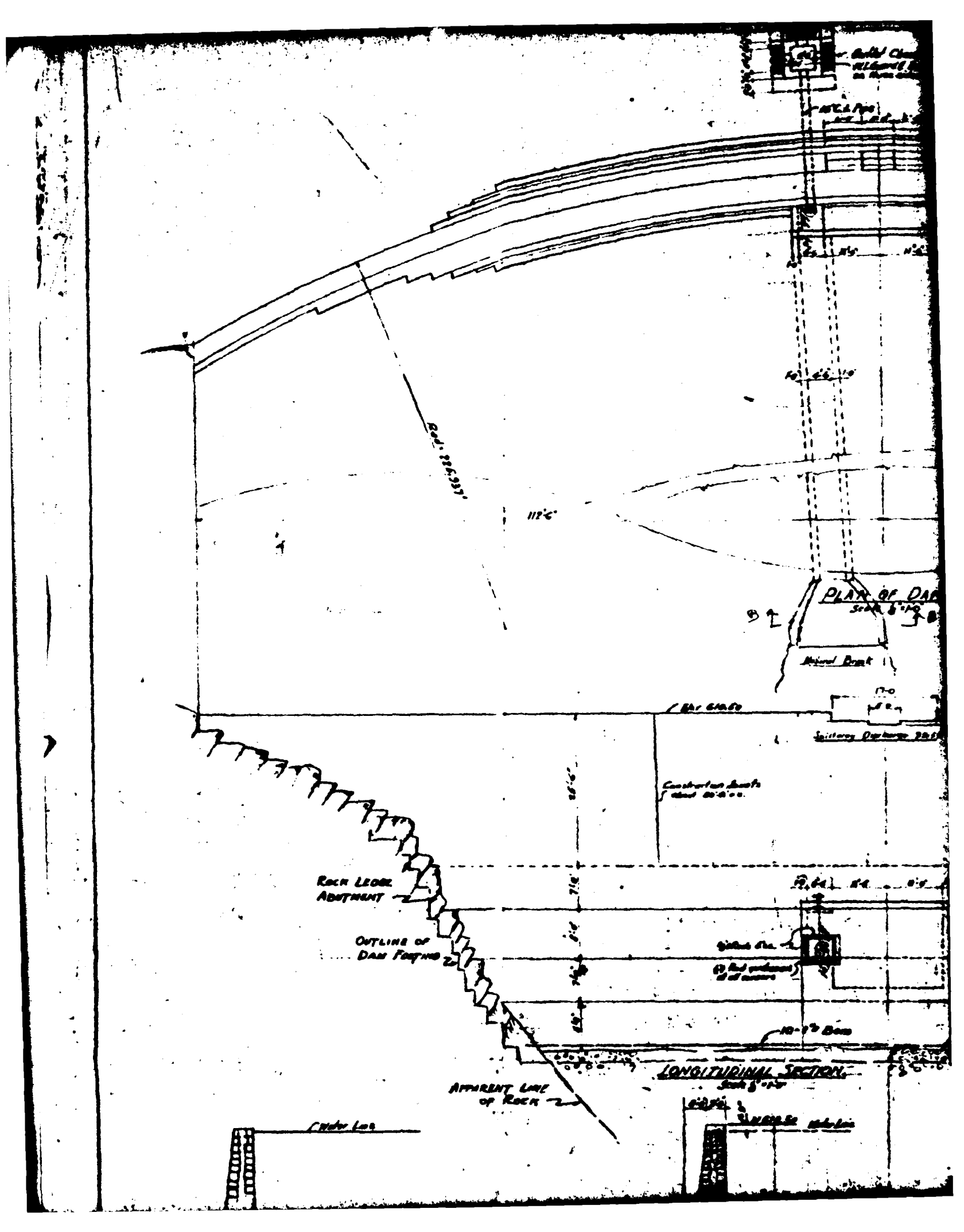
NORTH LAKE DAM NO. 3

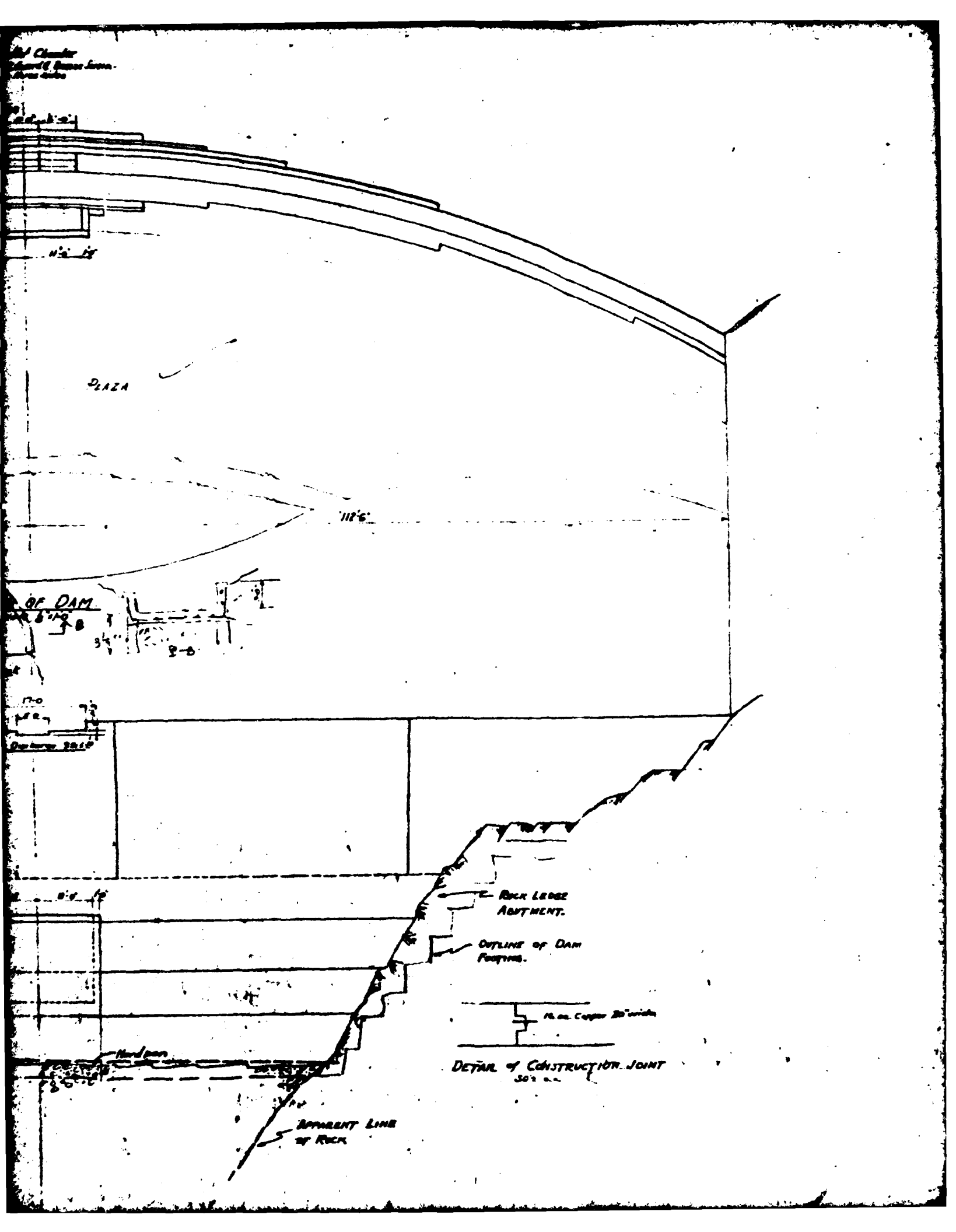
MT. KISCO, N.Y. QUAD

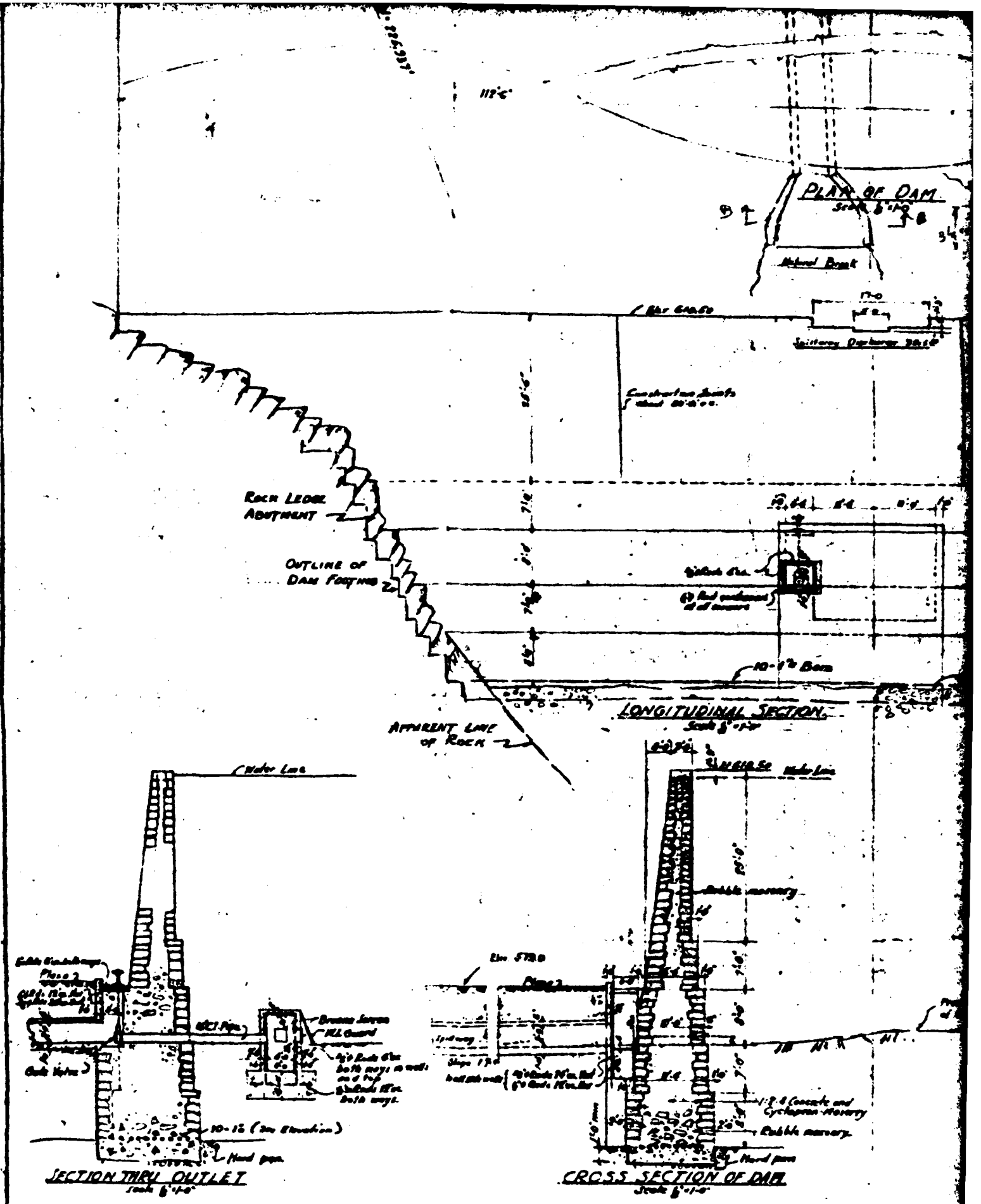


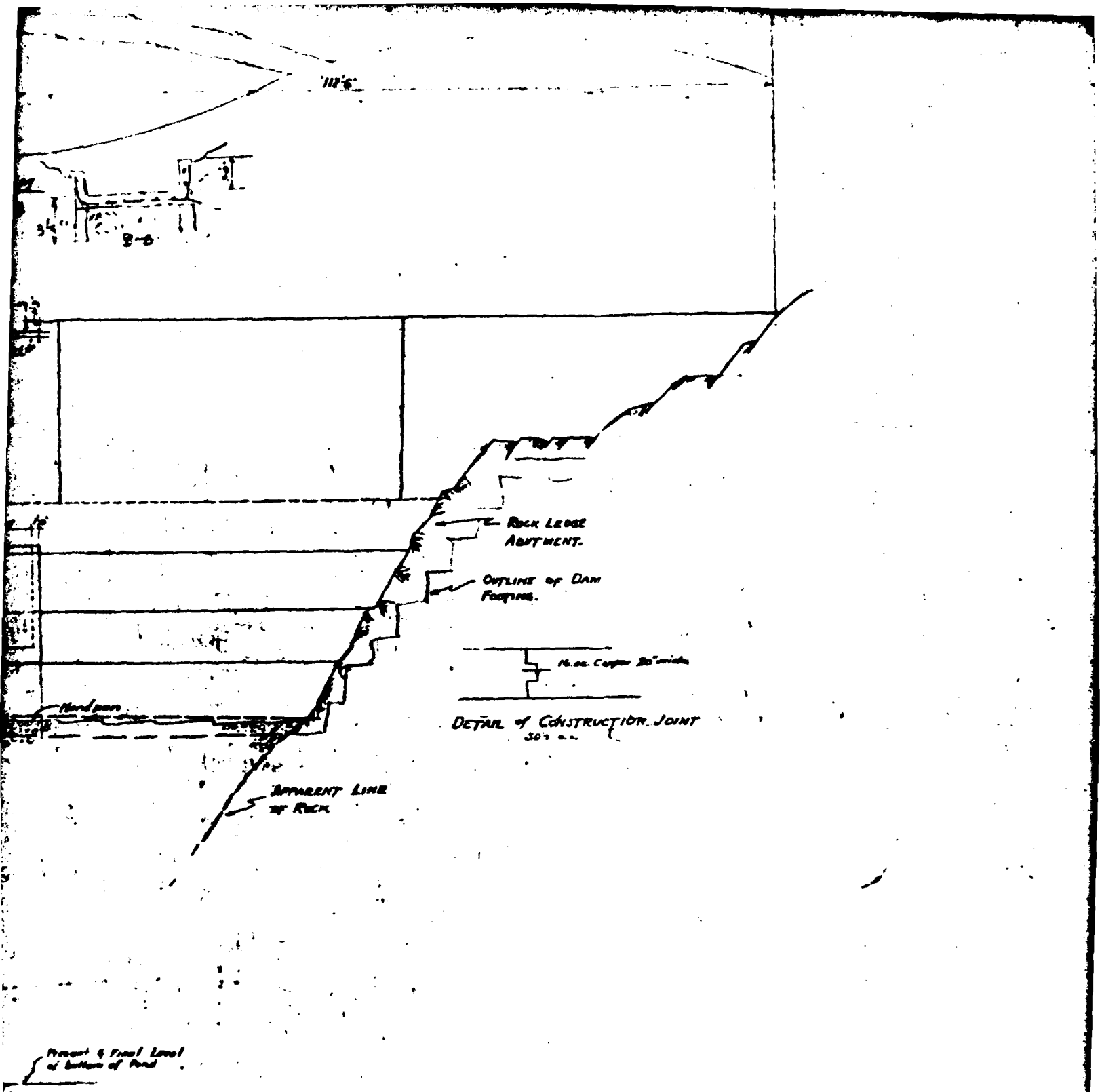
SCALE 1:24000

TOPOGRAPHIC MAP
NORTH LAKE DAM NO. 3


112°6'
PLAN OF DAM
LONGITUDINAL SECTION
ROCK LEDGE ABUTMENT
OUTLINE OF DAM FOOTING
APPARENT LINE OF ROCK


PLAZA
118'6"
OF DAM
ROCK LEDGE ABUTMENT.
OUTLINE OF DAM FOOTING.
DETAIL of CONSTRUCTION JOINT
APPARENT LINE OF ROCK


PLAN OF DAM
Natural Bank
Rock Ledge Abutment
Outline of Dam Footing
Apparent Line of Rock
LONGITUDINAL SECTION
Water Line
Rubble masonry
Elev 5720
Elev 5718.50
Rubble masonry
1:2:4 Concrete and Cyclopean Masonry
Rubble masonry
Hard pan
Hard pan
SECTION THRU OUTLET
CROSS SECTION OF DAM

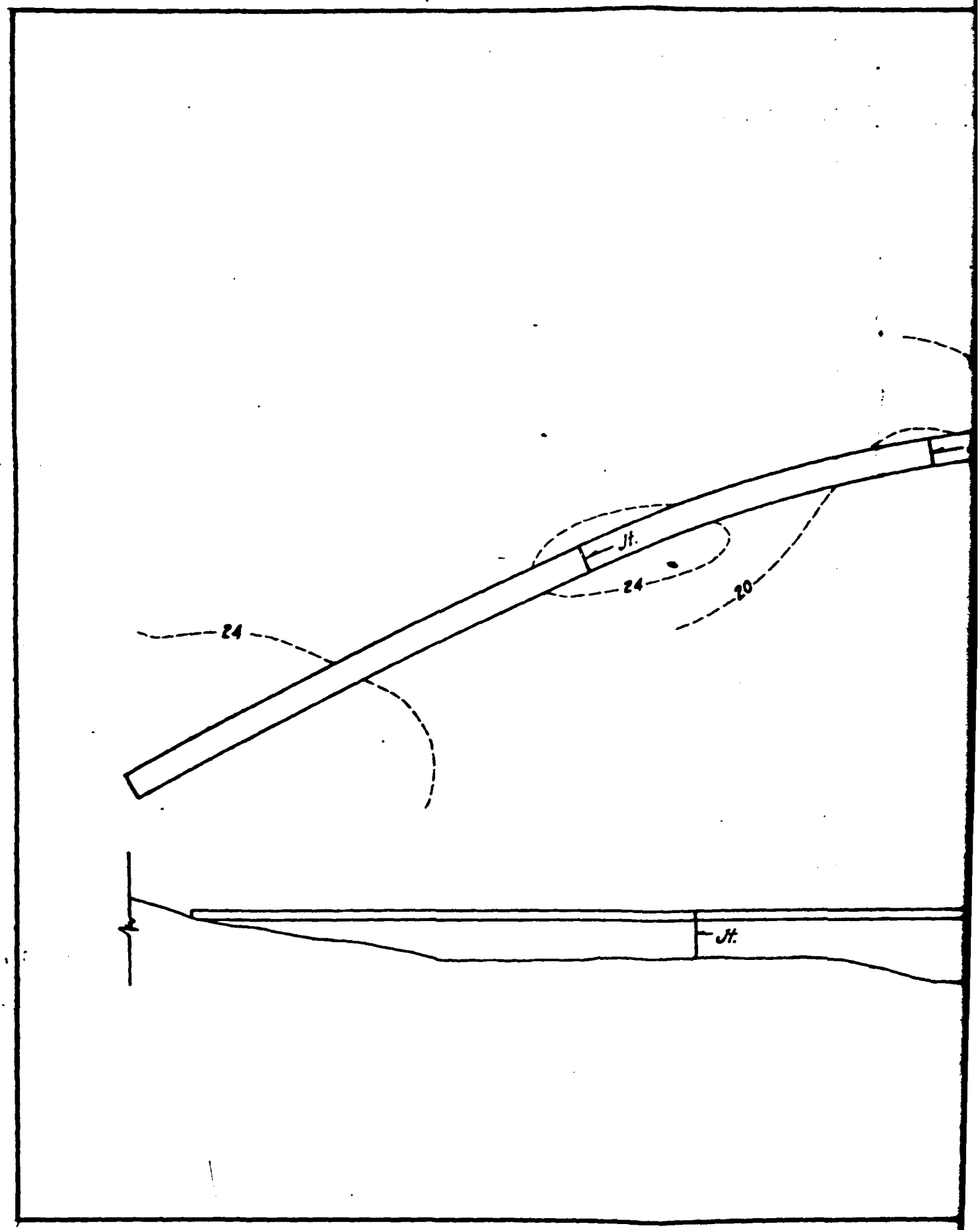


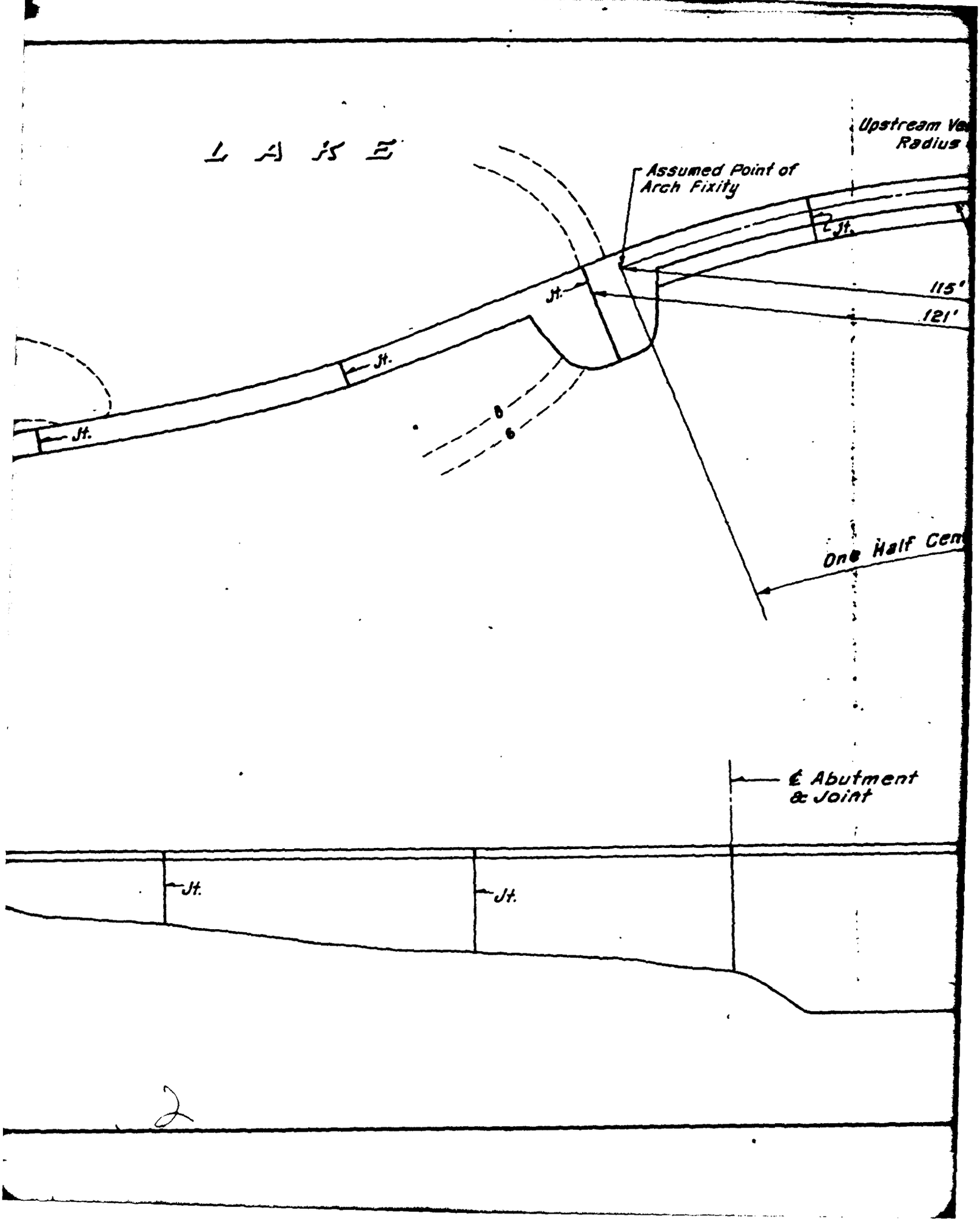
Note.- All bearings to be on rock or hardpan as indicated.

PROPOSED DAM No 3
FOR
SKYBEAM REALTY CO.
ARMONK N.Y.

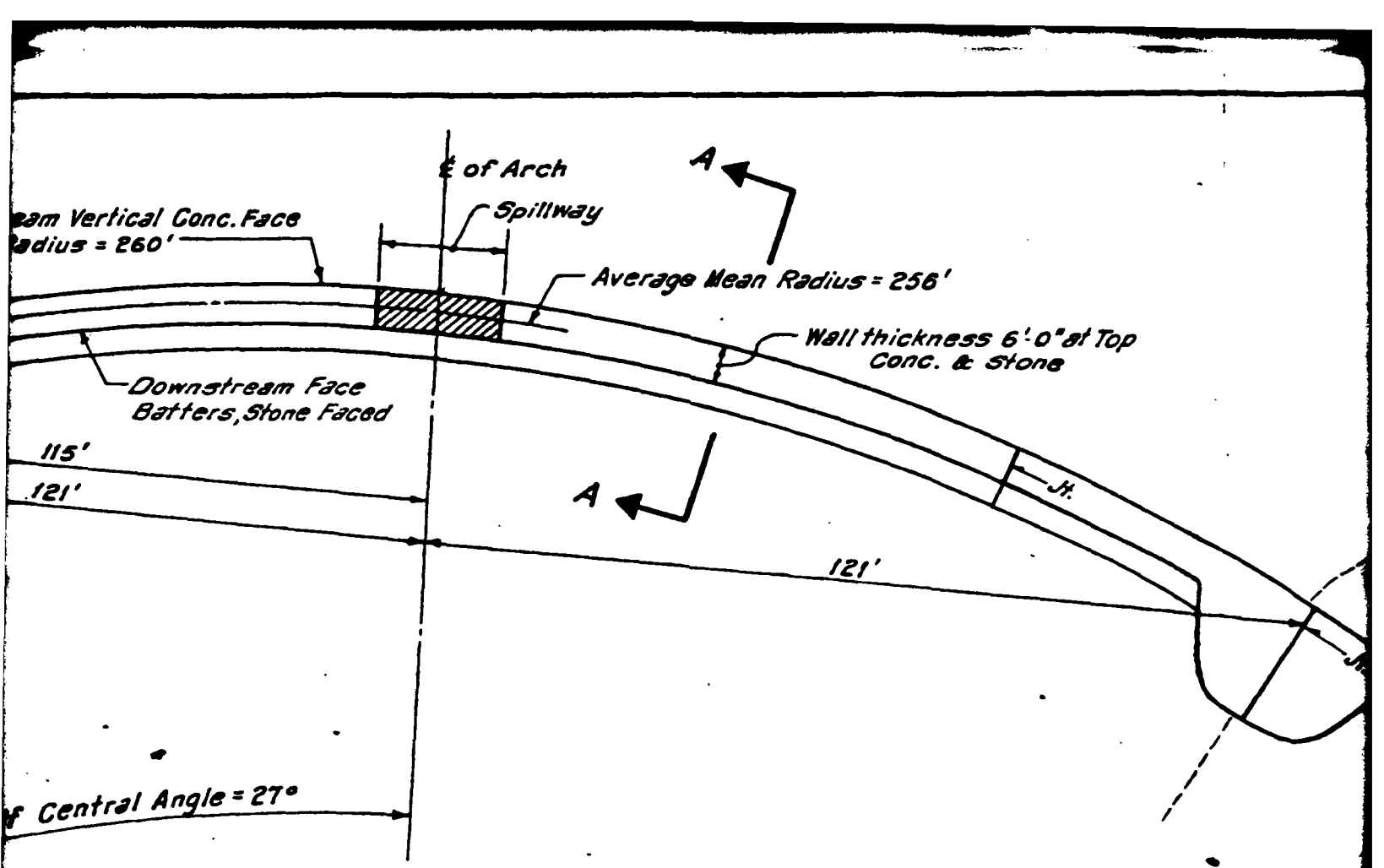
ELWYN P. SEELYE & CO. CONSULTING ENGRS
101 PARK AVE. NEW YORK, N.Y.

G.G.SC Rev. 6-19-36 Rev. 7/1/36


Jt.
24
20
24
Jt.

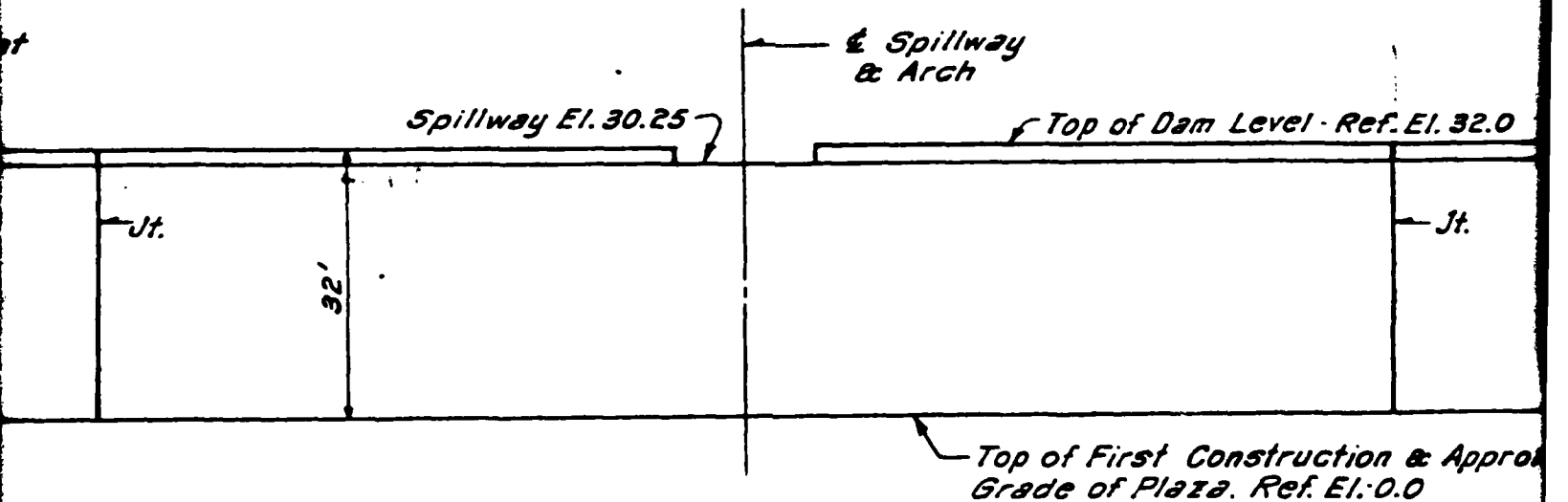

L A K E
Upstream Ve
Radius
Assumed Point of
Arch Fixity
Jt.
Jt.
Jt.
Jt.
115'
121'
One Half Cen
℄ Abutment
& Joint
Jt.
Jt.

2

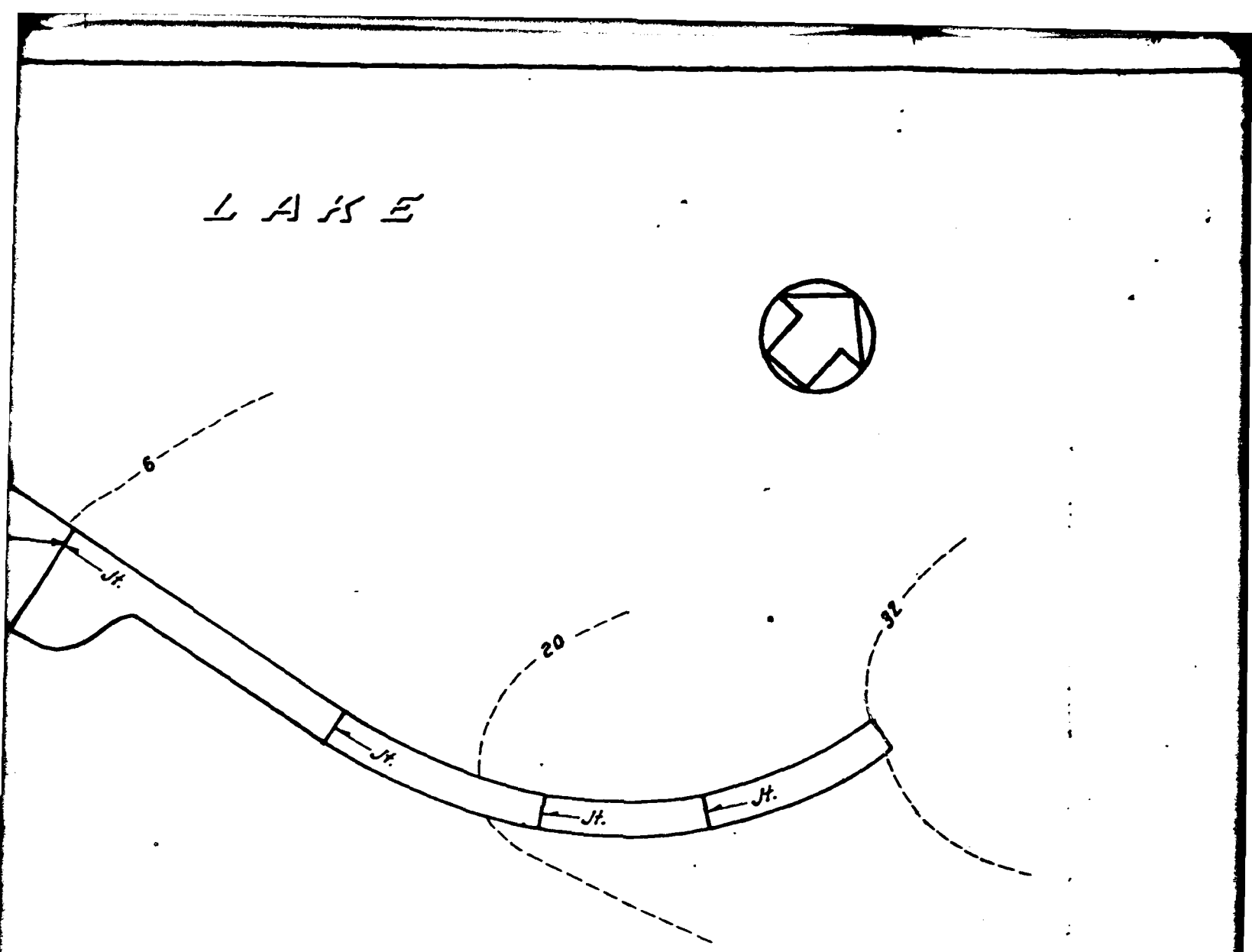


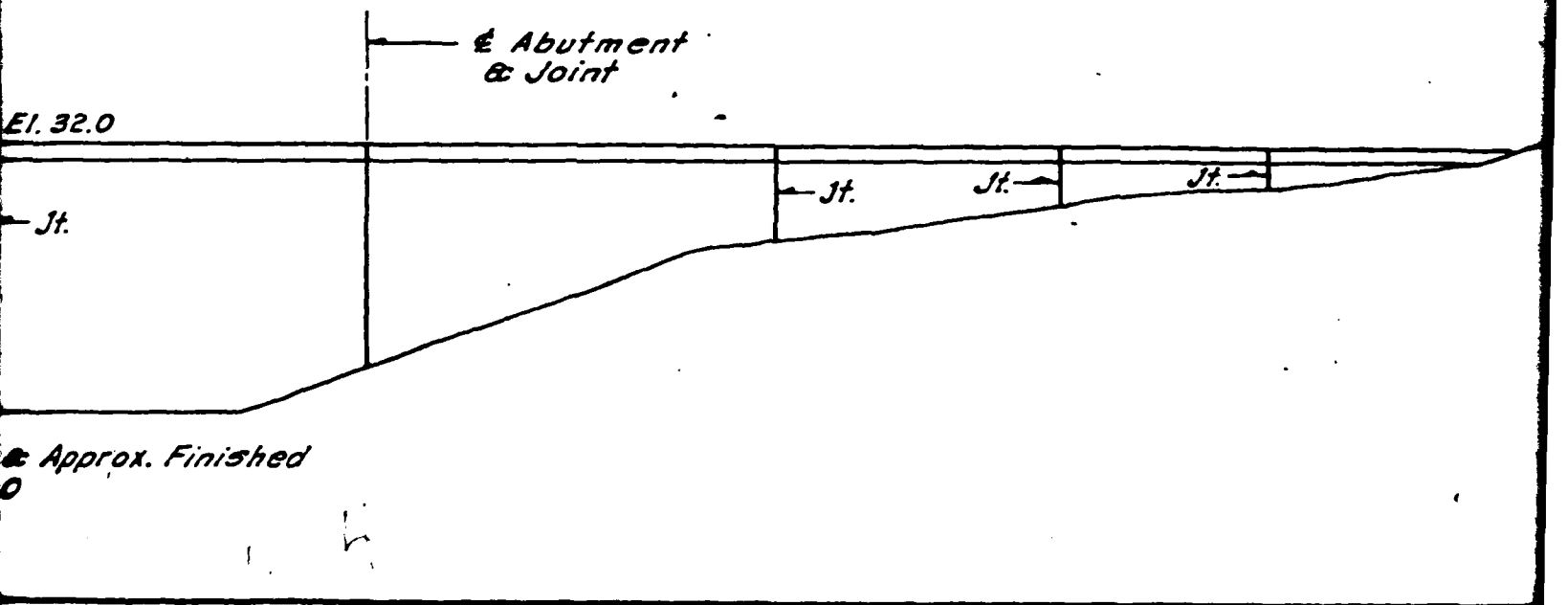
PLAN

Scale: 1" = 20'

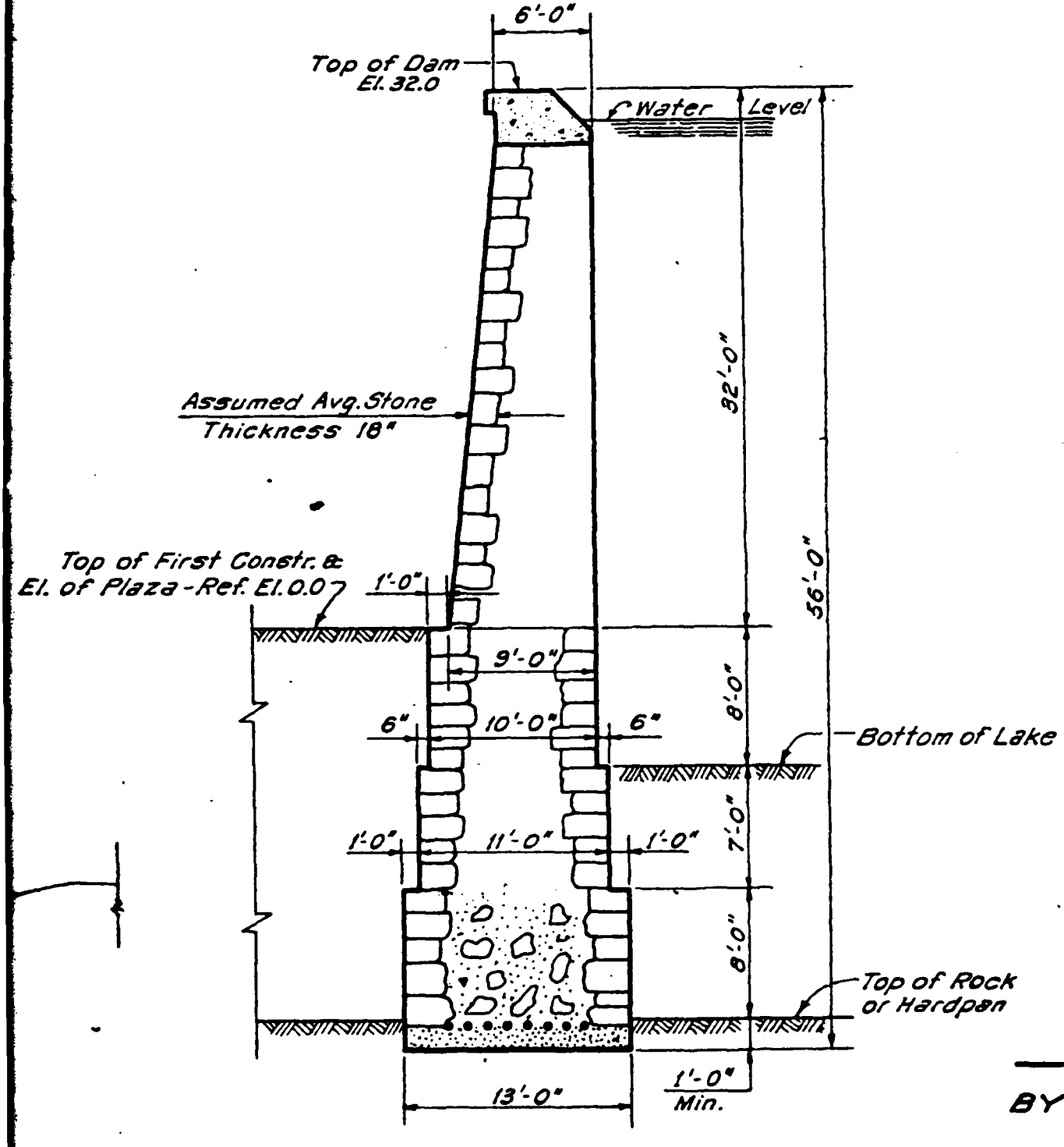


ELEVATION





℄ Approx. Finished
0



SECTION A-A

Scale: 1/8" = 1'-0"

NOTE:

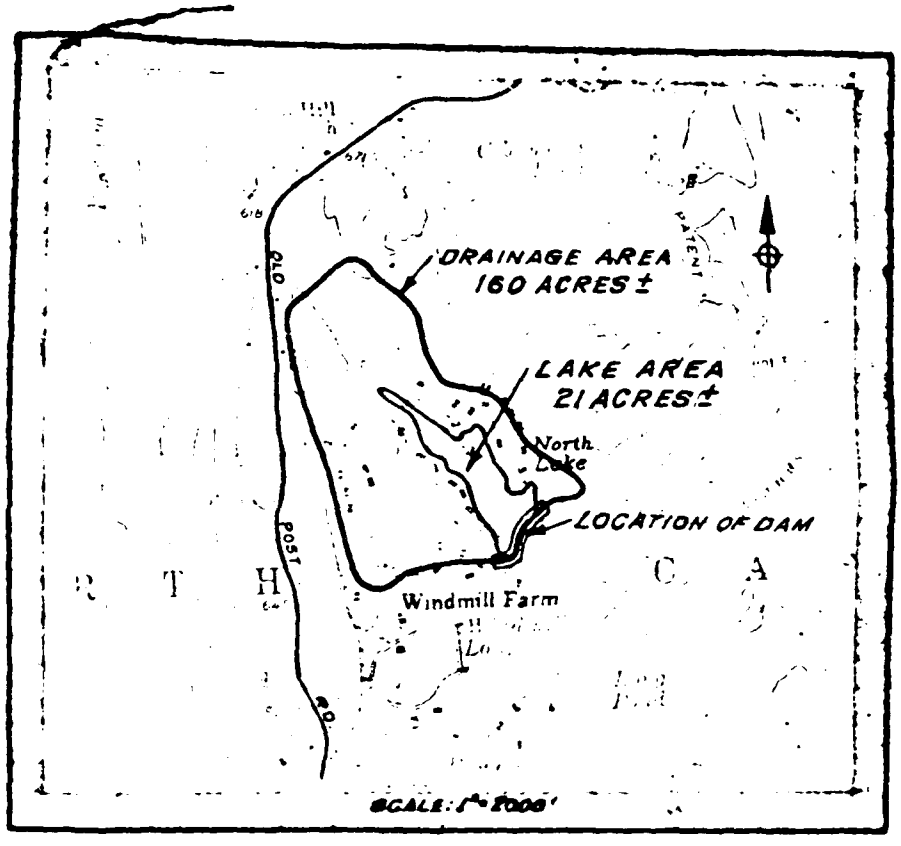
WIN

PREPA

BY: CHAS. H.

409

5



NOTE:

THIS DRAWING WAS PREPARED FROM A SKETCH BY RALPH L. MACDONALD, ACCOMPANYING HIS REPORT TO THE BUILDING INSPECTOR, TOWN OF NORTH CASTLE. DATED APRIL 17, 1964. INFORMATION CONTAINED THEREON FROM ORIGINAL CONSTRUCTION DRAWINGS. COMMENTS OR NOTES IN HEAVY "BLOCKS" ARE FROM THIS INSPECTION REPORT.

8kc

NORTH LAKE DAM

WINDMILL FARMS - ARMONK, N.Y.

PREPARED FOR: NORTH LAKE ASSOCIATION

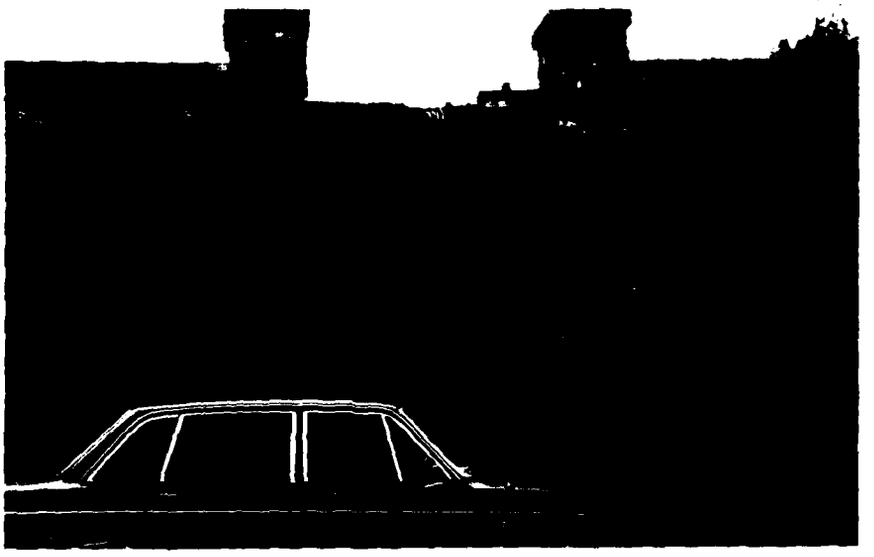
BY: CHAS. H. SELLS, INC., CIVIL ENGINEERS & SURVEYORS
409 MANVILLE ROAD, PLEASANTVILLE, N.Y.

SCALES: AS NOTED

JUNE 17, 1971 FILE Nº 71-145

PHOTOGRAPHS

APPENDIX B



2. DOWNSTREAM VIEW - CENTER SPILLWAY SECTION.

3. UPSTREAM VIEW - CENTER SPILLWAY SECTION.

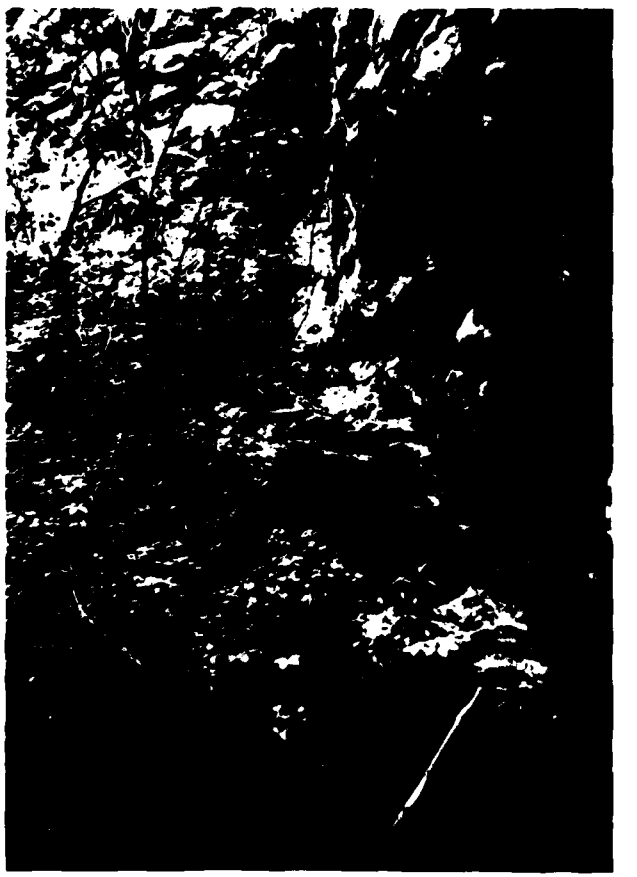
4. SPILLWAY COLLECTION WELL AS SEEN FROM CREST OF SPILLWAY.

5. SPILLWAY DISCHARGE CULVERT OUTLET AT HEAD OF CHANNEL. (NOTE: Debris at Head of Channel)

6. SEEPAGE FROM CRACKS ON FACE OF NORTH BUTTRESS.

7. CRACKS & SEEPAGE ON DOWNSTREAM FACE NEAR CENTER OF SPILLWAY. (NOTE: Vegetation Growing on Wall)

8. VEGETATION GROWING ON DOWNSTREAM DAM FACE, SOUTH OF SPILLWAY.



9. MINOR SEEPAGE AT SOUTH ABUTMENT

10. VIEW AT DAM TOE, NORTH OF SOUTH ABUTMENT. (NOTE: Surface Water and Lush "Marshy" Vegetation).

VISUAL INSPECTION CHECKLIST

APPENDIX C

VISUAL INSPECTION CHECKLIST

Basic Data

a. General

Name of Dam North Lake Dam No. 3

Fed. I.D. # NY113 DEC Dam No. 232-1093

River Basin Mianus

Location: Town North Castle County Westchester

Stream Name Unnamed

Tributary of Mianus River

Latitude (N) 41-08.9 Longitude (W) 073-40.5

Type of Dam Stone Masonry

Hazard Category 1

Date(s) of Inspection May 26, 1981

Weather Conditions Sunny & Warm 80°F

Reservoir Level at Time of Inspection El. 609±

b. Inspection Personnel Harvey Feldman, Principal Geotechnical Eng.
John Wallace, Geotechnical Engineer

c. Persons Contacted (Including Address & Phone No.)

Mr. Dan Qamar 25 Upland Lane Windmill Farms
Armonk, N.Y. 10504 (914) 273-3685

Mr. Ernest Ruoinger 38 North Lake Rd. Windmill Farms
Armonk, N.Y. 1050N (914)-273-3719

d. History:

Date Constructed 1936 Date(s) Reconstructed

Designer Elwyn E. Seelye & Co. Consulting Engineers N.Y., N.Y.

Constructed By Unknown

Owner North Lake Association

2. Embankment

a. Characteristics

(1) Embankment Material N/A

(2) Cutoff Type N/A

(3) Impervious Core N/A

(4) Internal Drainage System N/A

(5) Miscellaneous N/A

b. Crest

(1) Vertical Alignment N/A

(2) Horizontal Alignment N/A

(3) Surface Cracks N/A

(4) Miscellaneous N/A

c. Upstream Slope

(1) Slope (Estimate) (V:H) N/A

(2) Undesirable Growth or Debris, Animal Burrows N/A

(3) Sloughing, Subsidence or Depressions N/A

(4) Slope Protection N/A

(5) Surface Cracks or Movement at Toe N/A

d. Downstream Slope

(1) Slope (Estimate - V:H) N/A

(2) Undesirable Growth or Debris, Animal Burrows N/A

(3) Sloughing, Subsidence or Depressions N/A

(4) Surface Cracks or Movement at Toe N/A

(5) Seepage N/A

(6) External Drainage System (Ditches, Trenches; Blanket) N/A

(7) Condition Around Outlet Structure N/A

(8) Seepage Beyond Toe N/A

e. Abutments - Embankment Contact

N/A

(1) Erosion at Contact N/A

(2) Seepage Along Contact N/A

3) Drainage System

a. Description of System None

b. Condition of System N/A

c. Discharge from Drainage System N/A

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.) None

5) Reservoir

a. Slopes generally stable

b. Sedimentation No evidence of excessive sedimentation
No floating debris

c. Unusual Conditions Which Affect Dam None

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) few houses
town road

b. Seepage, Unusual Growth heavy vegetation including moderately
tall deciduous trees to 20-25', brushy marsh. Rips Tapoonabic Lowsit
toe collect surface run off, some under
c. Evidence of Movement Beyond Toe of Dam seepage probable
None

d. Condition of Downstream Channel downstream of box culvert much
brush & debris

7) Spillway(s) (Including Discharge Conveyance Channel)

Double level slot in center of crest w/ collection well at toe-water
transported via box culvert existing downstream of town road

a. General

b. Condition of Service Spillway good

c. Condition of Auxiliary Spillway None

d. Condition of Discharge Conveyance Channel Partially blocked by trees and debris

Reservoir Drain/Outlet

Type: Pipe X Conduit _____ Other _____

Material: Concrete _____ Metal Cast Iron Other _____

Size: 16 inch Length Approx 24 Feet

Invert Elevations: Entrance unknown Exit 533.75*

Physical Condition (Describe): Unobservable ✓

Material: _____

Joints: _____ Alignment _____

Structural Integrity: unknown

Hydraulic Capability: _____

Means of Control: Gate _____ Valve ✓ Uncontrolled _____

Operation: Operable _____ Inoperable ✓ Other _____

Present Condition (Describe): Reportedly difficult to operate and in poor working order - was not operated during inspection - Valve located d/s of Dam

* USGS Datum - Criscoon 1936 dwgs revised to correspond to USGS Elev.

f) Structural

a. Concrete Surfaces generally in good condition, some spalling at crest and on upstream face

b. Structural Cracking several minor cracks in masonry joints, some leaking, past cracks have been patched

c. Movement - Horizontal & Vertical Alignment (Settlement) None observed

d. Junctions with Abutments or Embankments good

e. Drains - Foundation, Joint, Face None

f. Water Passages, Conduits, Sluices Appear to be in good condition

g. Seepage or Leakage minor seepage from several "cracks" in masonry joints at various locations along the dam; some seepage evident near toe

h. Joints - Construction, etc. Masonry joints are generally in good condition, some pointing has been done both on upstream and downstream face in recent years

i. Foundation Hard pan under main section of dam with abutments set-ed into bedrock

j. Abutments Seepage evident at south abutment near rock-dam contact

k. Control Gates Inoperable

l. Approach & Outlet Channels No Approach Channel - outlet channel blocked with trees and debris

m. Energy Dissipators (Plunge Pool, etc.)

n. Intake Structures Not Visible

o. Stability Appears Stable

p. Miscellaneous

10) Appurtenant Structures (Powerhouse, Lock, Gatehouse, Other)

a. Description and Condition

See description of spillway (Item 7) and Reservoir Drain (Item 8)

HYDROLOGIC DATA AND COMPUTATIONS

APPENDIX D

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1) Top of Dam	573.75*	22.8	249
2) Design High Water (Max. Design Pool)	572.0*	—	210
3) Auxiliary Spillway Crest	None	—	—
4) Pool Level with Flashboards	N/A	—	—
5) Service Spillway Crest	572*	21.6	210

*USGS MSL Datum

DISCHARGES

	Volume (cfs)
1) Average Daily	Unknown
2) Spillway @ Maximum High Water	70.4
3) Spillway @ Design High Water	Unknown
4) Spillway @ Auxiliary Spillway Crest Elevation	None
5) Low Level Outlet	Unknown
6) Total (of all facilities) @ Maximum High Water	70.4
7) Maximum Known Flood	Unknown
8) At Time of Inspection	Unknown

DAM
CREST: ELEVATION: 573.75

Type: Rubble Masonry face Concrete & cyclopean Masonry Arch/Gravity

Width: 4 Feet Length: 600'

Spillover bi level slot

Location Spillover Top Center of dam

SPILLWAY:

SERVICE		AUXILIARY
572.0	Elevation	- none
bi-Level Slot	Type	
6.0 ft.	Width	
	Type of Control	
✓	Uncontrolled	
	Controlled:	
—	Type (Flashboards; gate)	
—	Number	
—	Size/Length	
	Invert Material	
	Anticipated Length of operating service	
NONE	Chute Length	
—	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	

HYDROMETEROLOGICAL GAGES:

Type : None

Location: —

Records:

Date - —

Max. Reading - —

FLOOD WATER CONTROL SYSTEM:

Warning System: None in existance

Method of Controlled Releases (mechanisms):

None - Reservoir design is inappropriate

DRAINAGE AREA: 0.26 sq miles

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Woods - Residential/Small farms

Terrain - Relief: Hilly

Surface - Soil: Glacial till

Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

None observed

Potential Sedimentation problem areas (natural or man-made; present or future)

None Observed

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

None

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: None

Elevation:

Reservoir:

Length @ Maximum Pool 0.36 (Miles)

Length of Shoreline (@ Spillway Crest) 0.98 (Miles)

TAMS

Job No. 1579-09 Sheet 1 of 24
Project NORTH LAKE DAM. NO 3 Date JUNE 16, 198
Subject HYDROLOGIC / HYDRAULIC COMPUTATIONS. By D.L.C
Ch'k. by

$L = 1.4" = 2800' = 0.53$ mi

$L_{CA} = 0.4" = 800' = 0.15$ mi

USE $C_t = 2$ $C_p = 0.625$

$T_p = 2[(0.53)(0.15)]^{0.3} = 0.94$ hrs.

$t_r = 0.94/5.5 = 0.17$ hrs for $t_R = 20$ min $= 0.33$ hrs.

$t_{PR} = t_p + 0.25(t_R - t_r)$
$= 0.94 + 0.25(0.33 - 0.17) = 0.98$ hrs.

ASSUME INITIAL LOSS = 1.0 in

" CONSTANT LOSS = 0.1 in/hour.

FROM Hydromet # 33

ALL SEASON 200 SQ MILE 24 HOUR PMP = 22 inches.

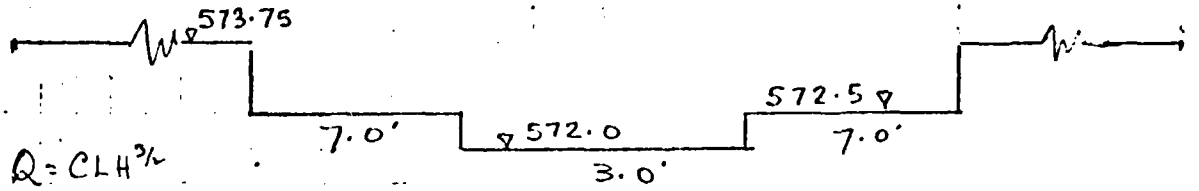
Duration (HRS	% PMP
6	112
12	123
24	133
48	141

$\frac{\text{LAKE AREA}}{\text{Drainage Area}}$ = % impervious = $\frac{21.6}{168.5} = 0.128$ (12.8%)

TAMS

Job No. 1579-09 Sheet 2 of 24
Project NORTH LAKE DAM INSPECTION Date JUNE 16 1981
Subject HYDROLOGIC/HYDRAULIC COMPUTATIONS By D.L.C
Ch'k. by JMD

SPILLWAY DISCHARGE CAPACITY BREADTH ≈ 60'



$Q = CLH^{3/2}$

EL.	L_1	H	C_1	Q_1 (CFS)	L_2	H	C_2	Q_2	Q_T
572	3	0	0		0	0			0
573	3	1	2.68	8	14	0.5	2.6	12.9	20.9
573.75	3	.75	2.65	18.4	14	1.25	2.66	52.0	70.4
575	3	3	2.66	41.5	14	2.5	2.67	147.8	189.3

FLOW OVER DAM.

TOP OF DAM 573.75

LENGTH OF DAM 600 - 17 = 583' (spillway length = 17.0')

C = 2.63

EXPD = 1.5

$B INPUT - DAM BREACH CRITERIA.

BRWID = 200'

Z = 3

ELBM = 542

TFAIL = 0.5 hours

WSEL = 572. FAILEL 574.

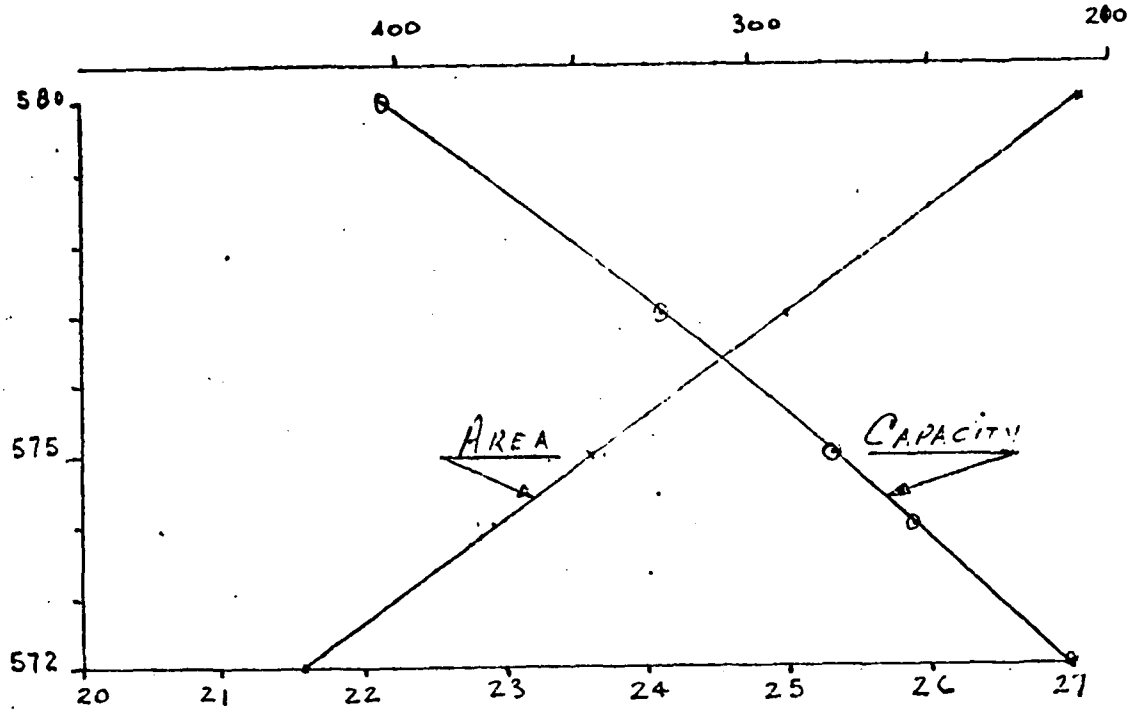
TAMS

Job No. _____ Sheet 3 of 24

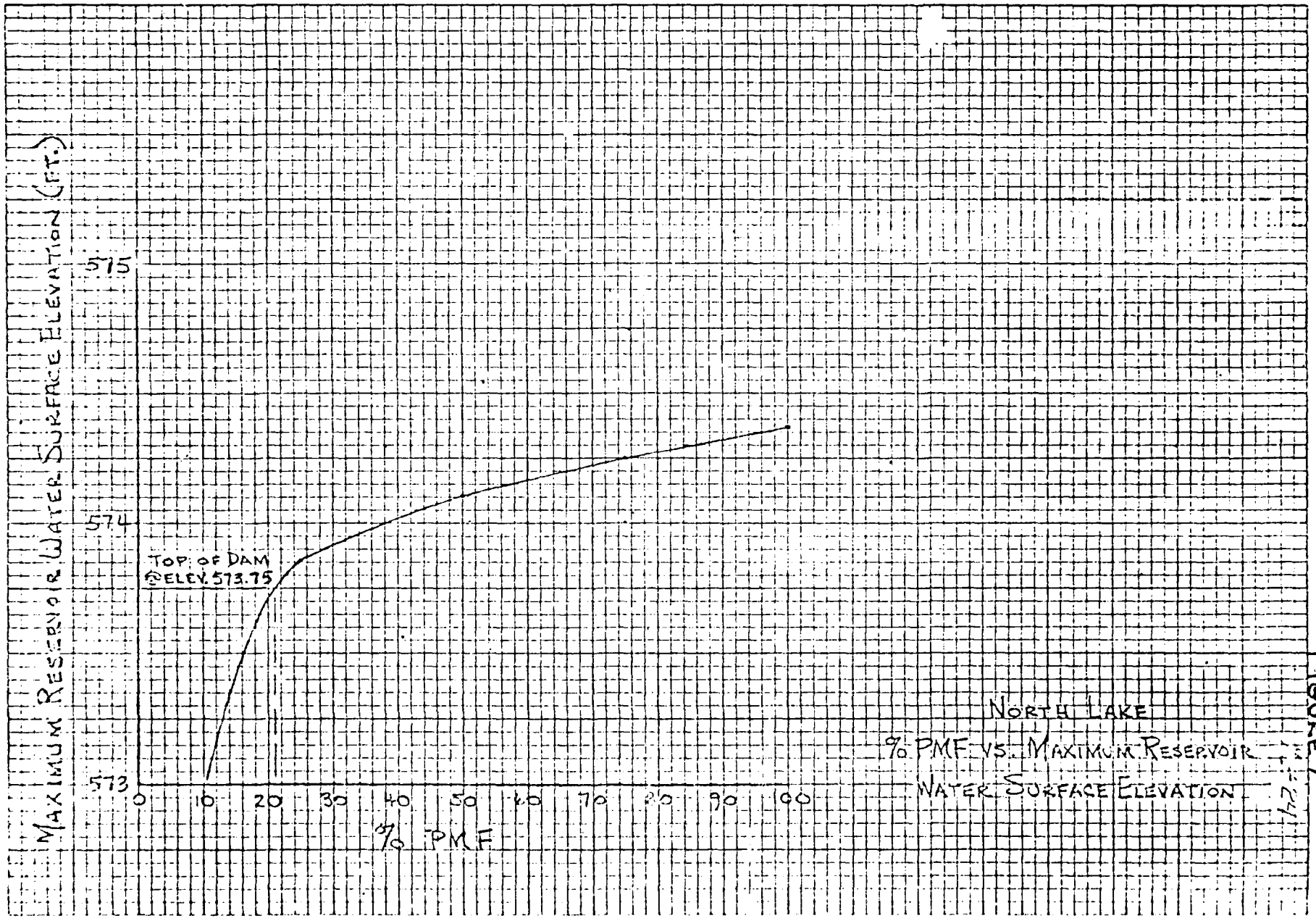
Project NORTH LAKE DAM NO 3 Date JUNE 18 81

Subject HYDROLOGIC / HYDRAULIC COMPUTATION By D.L.C.

Ch'k. by _____



EL	ΔH	AREA	MEAN AREA	Δ VOL	STORAGE (AC FT)
572		21.6			210 *
	2		22.25	44.5	
574		22.9			254.5
	1		23.25	23.25	
575		23.6			277.75
	2		24.3	48.6	
577		25.0			326.35
	3		26.05	78.15	
580		27.1			404.5



NORTH LAKE
% PMF VS. MAXIMUM RESERVOIR
WATER SURFACE ELEVATION

FIGURE E-27

```
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  01 APR 80

    1          A1                                   NORTH LAKE DAM NO 3
    2          A2                                   PHASE 1 SAFETY INSPECTION
    3          A3                                   HEC 1 DB PMF ANALYSIS
    4          B    150       0      20       0       0       0       0       0       0       0
    5          B1     5
    6          J      1       4       1
    7          J1     1    0.75     0.5    0.25
    8          K      0       1                                       1
    9          K1       1 NORTH LAKE BASIN RUN-OFF
   10          T      1       1    0.26            0.26                                   1
   11          P             22     112     123     133     141
   12          I                                                   1     0.1             .13
   13          M   0.98   0.625
   14          X     -1    -0.1     1.5
   15          K      1       2                                       1
   16          K1       2 ROUTE HYDROGRAPH THROUGH NORTH LAKE
   17          Y                                       1       1
   18          Y1     1                                           210      -1
   19          Y4   572     573  573.75     575
   20          Y5     0    20.9    70.4   189.3
   21          $S   210   254.5   277.8   326.4   404.5
   22          $E   572     574     575     577     580
   23          $S   572
   24          $D573.75     2.7     1.5     600
   25          K      1       3                                       1
   26          K1       3 CHANNEL ROUTE TO STATION 7+00
   27          Y                                       1       1
   28          Y1     1
   29          Y6 0.035   0.035   0.035     476     500     700   0.086
   30          Y7     0     560      30     490      60     480      72     476      30     476
   31          Y7   100     480     120     490     170     500
   32          K     99
```

Sheet 5 of 24

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
ROUTE HYDROGRAPH TO	3
END OF NETWORK	

Sheet 6 of 24

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 01 APR 80
****

RUN DATE= 81/06/22.
TIME= 15.48.53.

NORTH LAKE DAM NO 3
PHASE 1 SAFETY INSPECTION
HEC 1 DB PMF ANALYSIS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	20	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= 1.00 .75 .50 .25

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

1 NORTH LAKE BASIN RUN-OFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.26	0.00	.26	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.00	112.00	123.00	133.00	141.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	.13

UNIT HYDROGRAPH DATA
TP= .98 CP= .63 NTA= 0

RECESSION DATA
STRTQ= -1.00 QRCSN= -.10 RTIOR= 1.50
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.63 AND R= 2.36 INTERVALS

UNIT HYDROGRAPH 15 END-OF-PERIOD ORDINATES, LAG= .97 HOURS, CP= .62 VOL= 1.00

18.	62.	101.	103.	76.	50.	32.	21.	14.	9.
6.	4.	2.	2.	1.					

...STRTL= .00 UNLSTR= -.10 RTIOR= 1.50

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.63 AND R= 2.36 INTERVALS

UNI ROGR 5 ENG ... PERIOD ORDINATES LAG= .97 HOURS, CP= .62 VOL= 1.00

18. 62. 101. 103. 76. 50. 32. 21. 14. 9.

6. 4. 2. 2. 1.

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.20	1	.00	.00	.00	0.	1.02	1.20	76	.04	.01	.03	3.
1.01	.40	2	.00	.00	.00	0.	1.02	1.40	77	.04	.01	.03	4.
1.01	1.00	3	.00	.00	.00	0.	1.02	2.00	78	.04	.01	.03	4.
1.01	1.20	4	.00	.00	.00	0.	1.02	2.20	79	.04	.01	.03	5.
1.01	1.40	5	.00	.00	.00	0.	1.02	2.40	80	.04	.01	.03	5.
1.01	2.00	6	.00	.00	.00	0.	1.02	3.00	81	.04	.01	.03	5.
1.01	2.20	7	.00	.00	.00	0.	1.02	3.20	82	.04	.01	.03	5.
1.01	2.40	8	.00	.00	.00	0.	1.02	3.40	83	.04	.01	.03	5.
1.01	3.00	9	.00	.00	.00	0.	1.02	4.00	84	.04	.01	.03	5.
1.01	3.20	10	.00	.00	.00	0.	1.02	4.20	85	.04	.01	.03	5.
1.01	3.40	11	.00	.00	.00	0.	1.02	4.40	86	.04	.01	.03	5.
1.01	4.00	12	.00	.00	.00	0.	1.02	5.00	87	.04	.01	.03	5.
1.01	4.20	13	.00	.00	.00	0.	1.02	5.20	88	.04	.01	.03	5.
1.01	4.40	14	.00	.00	.00	0.	1.02	5.40	89	.04	.01	.03	5.
1.01	5.00	15	.00	.00	.00	0.	1.02	6.00	90	.04	.01	.03	5.
1.01	5.20	16	.00	.00	.00	0.	1.02	6.20	91	.11	.08	.03	6.
1.01	5.40	17	.00	.00	.00	0.	1.02	6.40	92	.11	.08	.03	11.
1.01	6.00	18	.00	.00	.00	0.	1.02	7.00	93	.11	.08	.03	18.
1.01	6.20	19	.01	.00	.01	0.	1.02	7.20	94	.11	.08	.03	25.
1.01	6.40	20	.01	.00	.01	0.	1.02	7.40	95	.11	.08	.03	30.
1.01	7.00	21	.01	.00	.01	0.	1.02	8.00	96	.11	.08	.03	33.
1.01	7.20	22	.01	.00	.01	0.	1.02	8.20	97	.11	.08	.03	35.
1.01	7.40	23	.01	.00	.01	0.	1.02	8.40	98	.11	.08	.03	37.
1.01	8.00	24	.01	.00	.01	0.	1.02	9.00	99	.11	.08	.03	38.
1.01	8.20	25	.01	.00	.01	0.	1.02	9.20	100	.11	.08	.03	38.
1.01	8.40	26	.01	.00	.01	0.	1.02	9.40	101	.11	.08	.03	39.
1.01	9.00	27	.01	.00	.01	0.	1.02	10.00	102	.11	.08	.03	39.
1.01	9.20	28	.01	.00	.01	0.	1.02	10.20	103	.11	.08	.03	39.
1.01	9.40	29	.01	.00	.01	0.	1.02	10.40	104	.11	.08	.03	39.
1.01	10.00	30	.01	.00	.01	0.	1.02	11.00	105	.11	.08	.03	39.
1.01	10.20	31	.01	.00	.01	0.	1.02	11.20	106	.11	.08	.03	39.
1.01	10.40	32	.01	.00	.01	0.	1.02	11.40	107	.11	.08	.03	39.
1.01	11.00	33	.01	.00	.01	0.	1.02	12.00	108	.11	.08	.03	39.
1.01	11.20	34	.01	.00	.01	0.	1.02	12.20	109	.66	.63	.03	49.
1.01	11.40	35	.01	.00	.01	0.	1.02	12.40	110	.66	.63	.03	83.
1.01	12.00	36	.01	.00	.01	0.	1.02	13.00	111	.66	.63	.03	139.
1.01	12.20	37	.04	.01	.03	1.	1.02	13.20	112	.79	.76	.03	198.
1.01	12.40	38	.04	.01	.03	1.	1.02	13.40	113	.79	.76	.03	248.
1.01	13.00	39	.04	.01	.03	1.	1.02	14.00	114	.79	.76	.03	289.
1.01	13.20	40	.05	.01	.04	2.	1.02	14.20	115	.99	.96	.03	324.
1.01	13.40	41	.05	.01	.04	2.	1.02	14.40	116	.99	.96	.03	358.
1.01	14.00	42	.05	.01	.04	2.	1.02	15.00	117	.99	.96	.03	392.
1.01	14.20	43	.06	.01	.05	3.	1.02	15.20	118	1.72	1.69	.03	434.
1.01	14.40	44	.06	.01	.05	3.	1.02	15.40	119	4.72	4.69	.03	555.
1.01	15.00	45	.06	.01	.05	3.	1.02	16.00	120	1.05	1.02	.03	764.
1.01	15.20	46	.10	.01	.09	4.	1.02	16.20	121	.92	.89	.03	922.
1.01	15.40	47	.29	.04	.25	4.	1.02	16.40	122	.92	.89	.03	914.
1.01	16.00	48	.06	.03	.04	6.	1.02	17.00	123	.92	.89	.03	790.
1.01	16.20	49	.06	.03	.03	9.	1.02	17.20	124	.72	.69	.03	668.
1.01	16.40	50	.06	.03	.03	11.	1.02	17.40	125	.72	.69	.03	577.
1.01	17.00	51	.06	.03	.03	12.	1.02	18.00	126	.72	.69	.03	506.
1.01	17.20	52	.04	.01	.03	12.	1.02	18.20	127	.06	.03	.03	440.
1.01	17.40	53	.04	.01	.03	12.	1.02	18.40	128	.06	.03	.03	362.
1.01	18.00	54	.04	.01	.03	11.	1.02	19.00	129	.06	.03	.03	271.
1.01	18.20	55	.00	.00	.00	9.	1.02	19.20	130	.06	.03	.03	187.
1.01	18.40	56	.00	.00	.00	8.	1.02	19.40	131	.06	.03	.03	126.

Sheet 2 of 24

1.01	19.00	57	.00	.00	.00	6.	1.02	20.00	132	.06	.03	.03	92.
1.01	19.20	58	.00	.00	.00	4.	1.02	20.20	133	.06	.03	.03	88.
1.01	19.40	59	.00	.00	.00	3.	1.02	20.40	134	.06	.03	.03	85.

1.01	17.20	52	.04	.01	.03	12.	1.02	18.00	126	.72	.69	.03	506.
1.01	17.40	53	.04	.01	.03	12.	1.02	18.20	127	.06	.03	.03	4
1.01	17.60	54	.04	.01	.03	12.	1.	8.40	128	6	.03	.03	3[illegible]
1.01	17.80	55	.04	.01	.03	11.	1.02	19.00	129	.06	.03	.03	271.
1.01	18.00	55	.00	.00	.00	9.	1.02	19.20	130	.06	.03	.03	187.
1.01	18.20	56	.00	.00	.00	8.	1.02	19.40	131	.06	.03	.03	126.
1.01	18.40	56	.00	.00	.00	8.	1.02	19.60	131	.06	.03	.03	126.
1.01	18.60	57	.00	.00	.00	7.	1.02	19.80	132	.06	.03	.03	107.
1.01	18.80	57	.00	.00	.00	6.	1.02	20.00	132	.06	.03	.03	92.
1.01	19.00	57	.00	.00	.00	6.	1.02	20.20	133	.06	.03	.03	88.
1.01	19.20	58	.00	.00	.00	4.	1.02	20.40	134	.06	.03	.03	85.
1.01	19.40	59	.00	.00	.00	3.	1.02	21.00	135	.06	.03	.03	81.
1.01	19.60	60	.00	.00	.00	2.	1.02	21.20	136	.06	.03	.03	78.
1.01	19.80	61	.00	.00	.00	1.	1.02	21.40	137	.06	.03	.03	75.
1.01	20.00	62	.00	.00	.00	1.	1.02	22.00	138	.06	.03	.03	72.
1.01	20.20	63	.00	.00	.00	1.	1.02	22.20	139	.06	.03	.03	69.
1.01	20.40	64	.00	.00	.00	1.	1.02	22.40	140	.06	.03	.03	66.
1.01	21.00	65	.00	.00	.00	1.	1.02	23.00	141	.06	.03	.03	64.
1.01	21.20	66	.00	.00	.00	1.	1.02	23.20	142	.06	.03	.03	61.
1.01	21.40	67	.00	.00	.00	1.	1.02	23.40	143	.06	.03	.03	59.
1.01	22.00	68	.00	.00	.00	1.	1.03	0.00	144	.06	.03	.03	56.
1.01	22.20	69	.00	.00	.00	1.	1.03	.20	145	0.00	0.00	0.00	54.
1.01	22.40	70	.00	.00	.00	1.	1.03	.40	146	0.00	0.00	0.00	52.
1.01	23.00	71	.00	.00	.00	1.	1.03	1.00	147	0.00	0.00	0.00	50.
1.02	0.00	72	.00	.00	.00	1.	1.03	1.20	148	0.00	0.00	0.00	48.
1.02	.20	73	.04	.01	.03	1.	1.03	1.40	149	0.00	0.00	0.00	46.
1.02	.40	74	.04	.01	.03	1.	1.03	2.00	150	0.00	0.00	0.00	44.
1.02	1.00	75	.04	.01	.03	2.							
									SUM	24.82	21.61	3.21	11637.
										(630.2)	(549.)	(82.)	(329.5)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	922.	500.	159.	78.	11630.
CMS	26.	14.	5.	2.	329.
INCHES		17.90	22.78	23.12	23.12
MM		454.78	578.69	587.15	587.15
AC-FT		248.	316.	320.	320.
THOUS CU M		306.	389.	395.	395.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	2.
2.	2.	3.	3.	4.	4.	6.	9.	11.	15.
12.	12.	12.	11.	9.	8.	6.	4.	3.	2.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	3.	4.	4.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.	5.	5.
6.	11.	18.	25.	30.	33.	35.	37.	38.	38.
39.	39.	39.	39.	39.	39.	39.	39.	49.	83.
139.	198.	248.	289.	324.	358.	392.	434.	555.	764.
922.	914.	790.	669.	577.	506.	440.	362.	271.	187.
126.	92.	88.	85.	81.	78.	75.	72.	69.	66.
64.	61.	59.	56.	54.	52.	50.	48.	46.	44.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	922.	500.	159.	78.	11630.
CMS	26.	14.	5.	2.	329.
INCHES		17.90	22.78	23.12	23.12
MM		454.78	578.69	587.15	587.15
AC-FT		248.	316.	320.	320.
THOUS CU M		306.	389.	395.	395.

Sheet 9 of 24

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

395. 395.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	1.	1.	1.
2.	2.	2.	2.	2.	3.	3.	5.	7.	8.
9.	9.	9.	8.	7.	6.	4.	3.	2.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	2.	3.	3.	3.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
5.	8.	13.	18.	22.	25.	27.	28.	28.	29.
29.	29.	29.	29.	30.	30.	30.	30.	37.	63.
104.	149.	186.	217.	243.	268.	294.	326.	416.	573.
692.	685.	592.	501.	433.	380.	330.	272.	203.	140.
95.	69.	66.	63.	61.	58.	56.	54.	52.	50.
48.	46.	44.	42.	41.	39.	37.	36.	35.	33.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	692.	375.	119.	58.	8722.
CMS	20.	11.	3.	2.	247.
INCHES		13.43	17.09	17.34	17.34
MM		341.09	434.02	440.36	440.36
AC-FT		186.	237.	240.	240.
THOUS CU M		230.	292.	296.	296.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	1.	1.	1.	2.	2.	2.	3.	4.	5.
6.	6.	5.	5.	4.	3.	2.	1.	1.	1.
1.	1.	1.	1.	1.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	2.	2.	2.	2.
2.	2.	2.	3.	3.	3.	3.	3.	3.	3.
3.	5.	9.	12.	15.	17.	18.	18.	19.	19.
19.	20.	20.	20.	20.	20.	20.	20.	25.	42.
70.	99.	126.	145.	162.	179.	196.	217.	278.	382.
461.	457.	395.	334.	288.	253.	220.	181.	135.	93.
63.	46.	44.	42.	41.	39.	37.	36.	35.	33.
32.	31.	29.	28.	27.	26.	25.	24.	23.	22.

	PEAK	6-HOUR	24-HOUR	72-HOUP	TOTAL VOLUME
CFS	461.	250.	80.	39.	5815.
CMS	13.	7.	2.	1.	165.
INCHES		8.95	11.39	11.56	11.56
MM		227.39	289.34	293.58	293.58
AC-FT		124.	158.	160.	160.
THOUS CU M		153.	195.	198.	198.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	2.	2.	3.

Sheet 10 of 24

3.	3.	3.	3.	2.	2.	1.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	2.	2.	3.
3.	3.	3.	3.	2.	2.	1.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	3.	4.	6.	7.	8.	9.	9.	9.	10.
10.	10.	10.	10.	10.	10.	10.	10.	12.	21.
35.	50.	62.	72.	81.	89.	98.	109.	139.	191.
231.	228.	197.	167.	144.	127.	110.	91.	68.	47.
32.	23.	22.	21.	20.	19.	19.	18.	17.	17.
16.	15.	15.	14.	14.	13.	12.	12.	12.	11.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	231.	125.	40.	19.	2907.
CMS	7.	4.	1.	1.	82.
INCHES		4.48	5.70	5.78	5.78
MM		113.70	144.67	146.79	146.79
AC-FT		62.	79.	80.	80.
THOUS CU M		77.	97.	99.	99.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

2 ROUTE HYDROGRAPH THROUGH NORTH LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STOPA	ISPRAT
1	0	0	0.000	0.000	0.000	210.	-1

STAGE	572.00	573.00	573.75	575.00
FLOW	0.00	20.90	70.40	189.30
CAPACITY=	210.	255.	278.	326.	405.
ELEVATION=	572.	574.	575.	577.	580.

CPEL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
572.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
573.8	2.7	1.5	600.

STATION 2, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Sheet 11 of 24

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	2.	2.	3.

3.	3.	3.	3.	2.	2.	1.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	3.	4.	6.	7.	8.	9.	9.	9.	10.
10.	10.	10.	10.	10.	10.	10.	10.	12.	21.
35.	50.	62.	72.	81.	89.	98.	109.	139.	191.
231.	228.	197.	167.	144.	127.	110.	91.	68.	47.
32.	23.	22.	21.	20.	19.	19.	18.	17.	17.
16.	15.	15.	14.	14.	13.	12.	12.	12.	11.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	231.	125.	40.	19.	2907.
CMS	7.	4.	1.	1.	82.
INCHES		4.48	5.70	5.78	5.78
MM		113.70	144.67	146.79	146.79
AC-FT		62.	79.	80.	80.
THOUS CU M		77.	97.	99.	99.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

2 ROUTE HYDROGRAPH THROUGH NORTH LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	210.	-1

STAGE	572.00	573.00	573.75	575.00
FLOW	0.00	20.90	70.40	189.30
CAPACITY=	210.	255.	278.	326.	405.
ELEVATION=	572.	574.	575.	577.	580.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
572.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
573.8	2.7	1.5	600.

STATION 2, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	1.	1.	1.	1.

END-OF-PERIOD HYDROGRAPH ORDINATES

FLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	1.	1.	1.	1.
2.	2.	2.	2.	2.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	3.	3.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	4.	5.	5.	6.	7.	8.	8.
9.	10.	11.	11.	12.	13.	13.	14.	15.	16.
19.	26.	41.	59.	124.	290.	367.	410.	491.	660.
852.	923.	846.	722.	619.	541.	473.	405.	324.	241.
172.	126.	103.	93.	87.	83.	80.	77.	74.	72.
70.	70.	69.	68.	67.	66.	65.	64.	62.	61.

STORAGE

210.	210.	210.	210.	210.	210.	210.	210.	210.	210.
210.	210.	210.	210.	210.	210.	210.	210.	210.	210.
210.	210.	210.	210.	210.	210.	210.	210.	210.	210.
210.	210.	210.	210.	210.	210.	210.	210.	210.	210.
210.	210.	210.	211.	211.	211.	211.	211.	211.	211.
212.	212.	212.	212.	213.	213.	213.	213.	213.	213.
213.	213.	213.	213.	213.	213.	213.	213.	213.	213.
213.	212.	212.	212.	212.	212.	212.	212.	213.	213.
213.	213.	213.	213.	213.	213.	213.	213.	213.	213.
213.	213.	214.	214.	215.	214.	216.	217.	218.	219.
220.	220.	221.	222.	223.	224.	224.	225.	226.	227.
230.	234.	239.	245.	251.	255.	256.	256.	258.	260.
262.	263.	262.	261.	259.	258.	257.	256.	255.	254.
252.	251.	250.	250.	250.	250.	250.	249.	249.	249.
249.	249.	248.	248.	248.	247.	247.	247.	246.	246.

STAGE

572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0
572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0
572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0
572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0
572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.1
572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1
572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1
572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1
572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1
572.1	572.2	572.2	572.2	572.2	572.2	572.3	572.3	572.4	572.4
572.4	572.5	572.5	572.5	572.6	572.6	572.6	572.7	572.7	572.8
572.9	573.1	573.3	573.6	573.8	574.0	574.1	574.1	574.1	574.2
574.3	574.4	574.3	574.3	574.2	574.2	574.1	574.1	574.0	574.0
573.9	573.8	573.8	573.8	573.8	573.8	573.8	573.8	573.8	573.8
573.7	573.7	573.7	573.7	573.7	573.7	573.7	573.6	573.6	573.6

PEAK OUTFLOW IS 923. AT TIME 40.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	923.	477.	142.	69.	10330.
CMS	26.	14.	4.	2.	293.
INCHES		17.07	20.38	20.53	20.53
CM		433.48	517.56	521.54	521.54
AC-FT		237.	282.	285.	285.
THOUS CU M		292.	348.	351.	351.

Sheet 13 of 24

STATION 2, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

```
                               237.      282.      285.               285.
           THOUS CU M          292.      348.      351.                  .

                                    STATION      2, PLAN 1, RATIO 2

                                  END-OF-PERIOD HYDROGRAPH ORDINATES

                                               OUTFLOW
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        1.        1.        1.        1.
               1.        1.        2.        2.        2.        2.        2.        2.        2.        2.
               2.        2.        2.        2.        2.        2.        2.        2.        2.        2.
               2.        2.        2.        2.        2.        2.        2.        2.        2.        2.
               2.        2.        2.        2.        2.        2.        2.        2.        2.        2.
               2.        2.        3.        3.        3.        4.        4.        5.        6.        6.
               7.        7.        8.        8.        9.       10.       10.       11.       11.       12.
              14.       17.       21.       34.       50.       66.      165.      285.      362.      487.
             632.      690.      638.      546.      468.      409.      359.      307.      246.      185.
             134.      100.       82.       74.       71.       70.       69.       68.       66.       65.
              64.       63.       61.       60.       58.       57.       55.       54.       52.       51.

                                               STORAGE
             210.      210.      210.      210.      210.      210.      210.      210.      210.      210.
             210.      210.      210.      210.      210.      210.      210.      210.      210.      210.
             210.      210.      210.      210.      210.      210.      210.      210.      210.      210.
             210.      210.      210.      210.      210.      210.      210.      210.      210.      210.
             210.      210.      210.      210.      210.      211.      211.      211.      211.      211.
             211.      211.      212.      212.      212.      212.      212.      212.      212.      212.
             212.      212.      212.      212.      212.      212.      212.      212.      212.      212.
             212.      212.      212.      212.      212.      212.      212.      212.      212.      212.
             212.      212.      212.      212.      212.      212.      212.      212.      212.      212.
             212.      213.      213.      213.      214.      214.      215.      215.      216.      217.
             217.      219.      219.      219.      220.      220.      221.      221.      222.      223.
             225.      228.      232.      237.      242.      247.      252.      254.      256.      258.
             260.      260.      260.      259.      257.      256.      256.      255.      254.      252.
             251.      250.      250.      249.      249.      249.      248.      249.      248.      247.
             247.      246.      246.      245.      245.      244.      244.      243.      243.      242.

                                                STAGE
            572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0
            572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0
            572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0
            572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0
            572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0
            572.1     572.1     572.1     572.1     572.1     572.1     572.1     572.1     572.1     572.1
            572.1     572.1     572.1     572.1     572.1     572.1     572.1     572.1     572.1     572.1
            572.1     572.1     572.1     572.1     572.1     572.1     572.1     572.1     572.1     572.1
            572.1     572.1     572.1     572.1     572.1     572.1     572.1     572.1     572.1     572.1
            572.1     572.1     572.1     572.1     572.2     572.2     572.2     572.2     572.3     572.3
            572.3     572.4     572.4     572.4     572.4     572.5     572.5     572.5     572.5     572.6
            572.7     572.8     573.0     573.2     573.4     573.7     573.9     574.0     574.0     574.1
            574.2     574.2     574.2     574.2     574.1     574.1     574.0     574.0     574.0     573.9
            573.9     573.8     573.8     573.8     573.8     573.7     573.7     573.7     573.7     573.7
            573.7     573.6     573.6     573.6     573.6     573.5     573.5     573.5     573.5     573.5

  PEAK OUTFLOW IS      690. AT TIME  40.67 HOURS

                                PEAK    6-HOUR    24-HOUR    72-HOUR    TOTAL VOLUME

                                                                              [illegible]

                       CFS       690.      342.      104.       50.           7544.
                       CMS        20.       10.        3.        1.            214.
                    INCHES                12.25     14.88     15.00           15.00
                        MM               311.21    377.89    380.87          380.87
```

```
                                                        573.5     573.5     573.5     573.5
 PEAK OUTFLOW IS      690. AT TIME  40.47 HOURS

                          PEAK    6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME

                   CFS     690.     342.      104.       50.        7544.
                   CMS      20.      10.        3.        1.         214.
                INCHES              12.25     14.88     15.00       15.00
                    MM             311.21    377.89    380.87      380.87
                 AC-FT               170.      206.      208.        208.
            THOUS CU M               209.      254.      256.        256.

                                        STATION     2, PLAN 1, RATIO 3

                                  END-OF-PERIOD HYDROGRAPH ORDINATES

                                               OUTFLOW
        0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
        0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
        0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
        0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
        0.         0.         0.         0.         0.         0.         0.         0.         1.         1.
        1.         1.         1.         1.         1.         1.         1.         1.         1.         1.
        1.         1.         1.         1.         1.         1.         1.         1.         1.         1.
        1.         1.         1.         1.         1.         1.         1.         1.         1.         1.
        1.         1.         1.         1.         1.         1.         1.         1.         1.         2.
        2.         2.         2.         2.         2.         3.         3.         3.         4.         4.
        5.         5.         5.         6.         6.         6.         7.         7.         7.         8.
        9.        11.        14.        17.        20.        31.        43.        56.        72.       253.
      404.       456.       428.       362.       317.       276.       242.       208.       169.       129.
       96.        75.        69.        67.        65.        63.        61.        59.        57.        56.
       54.        52.        50.        49.        47.        45.        44.        42.        41.        39.

                                               STORAGE
      210.       210.       210.       210.       210.       210.       210.       210.       210.       210.
      210.       210.       210.       210.       210.       210.       210.       210.       210.       210.
      210.       210.       210.       210.       210.       210.       210.       210.       210.       210.
      210.       210.       210.       210.       210.       210.       210.       210.       210.       210.
      210.       210.       210.       210.       210.       210.       210.       210.       211.       211.
      211.       211.       211.       211.       211.       211.       211.       211.       211.       211.
      211.       211.       211.       211.       211.       211.       211.       211.       211.       211.
      211.       211.       211.       211.       211.       211.       211.       211.       211.       211.
      211.       211.       211.       211.       211.       211.       212.       212.       212.       212.
      212.       212.       212.       212.       212.       213.       213.       214.       214.       214.
      215.       215.       216.       216.       216.       217.       217.       217.       218.       219.
      220.       222.       225.       225.       232.       236.       240.       244.       249.       254.
      256.       257.       257.       256.       255.       254.       254.       253.       252.       251.
      250.       249.       249.       248.       247.       247.       246.       245.       245.       244.
      243.       243.       242.       242.       241.       241.       240.       239.       239.       238.

                                               STAGE
     572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0
     572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0
     572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0
     572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0
     572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0      572.0
     572.0      572.0      572.0      572.1      572.1      572.1      572.1      572.1      572.1      572.1
     572.1      572.1      572.1      572.1      572.1      572.1      572.1      572.1      572.1      572.1
     572.1      572.1      572.1      572.1      572.1      572.1      572.1      572.1      572.1      572.1
     572.1      572.1      572.1      572.1      572.1      572.1      572.1      572.1      572.1      572.1
     572.1      572.1      572.1      572.1      572.1      572.1      572.1      572.2      572.2      572.2
     572.2      572.2      572.3      572.3      572.3      572.3      572.3      572.3      572.4      572.4
     572.4      572.5      572.7      572.8      573.0      573.2      573.3      573.5      573.8      574.0

     574.1      574.1      574.1      574.1      574.0      574.0      574.0      573.9      573.9      573.8
```

Sheet 15 of 24

572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1
572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1	572.1
[illegible]	[illegible]	[illegible]	[illegible]	572.1	572.	572	57.	5[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	572.3	572.3	572.4	572.4
572.4	572.5	572.7	572.8	573.0	573.2	573.3	573.5	573.8	574.0

574.1	574.1	574.1	574.1	574.0	574.0	574.0	573.9	573.9	573.8
573.8	573.8	573.7	573.7	573.7	573.6	573.6	573.6	573.6	573.5
573.5	573.5	573.4	573.4	573.4	573.4	573.3	573.3	573.3	573.3

PEAK OUTFLOW IS 456. AT TIME 40.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	456.	209.	66.	32.	4781.
CMS	13.	6.	2.	1.	135.
INCHES		7.46	9.43	9.50	9.50
MM		189.57	239.40	241.39	241.39
AC-FT		103.	131.	132.	132.
THOUS CU M		126.	161.	162.	162.

STATION 2, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	2.	2.	2.
2.	2.	3.	3.	3.	3.	3.	4.	4.	4.
5.	6.	7.	8.	10.	12.	14.	16.	19.	27.
41.	56.	69.	116.	143.	138.	124.	109.	91.	75.
69.	65.	62.	59.	56.	53.	50.	48.	46.	43.
41.	39.	37.	36.	34.	32.	31.	29.	28.	27.

STORAGE

210.	210.	210.	210.	210.	210.	210.	210.	210.	210.
210.	210.	210.	210.	210.	210.	210.	210.	210.	210.
210.	210.	210.	210.	210.	210.	210.	210.	210.	210.
210.	210.	210.	210.	210.	210.	210.	210.	210.	210.
210.	210.	210.	210.	210.	210.	210.	210.	210.	210.
210.	210.	211.	211.	211.	211.	211.	211.	211.	211.
211.	211.	211.	211.	211.	211.	211.	211.	211.	211.
211.	211.	211.	211.	211.	211.	211.	211.	211.	211.
211.	211.	211.	211.	211.	211.	211.	211.	211.	211.
211.	211.	211.	211.	211.	211.	212.	212.	212.	212.
212.	213.	213.	213.	213.	213.	214.	214.	214.	214.
215.	216.	217.	219.	221.	223.	225.	228.	230.	234.
239.	244.	248.	251.	251.	251.	251.	251.	250.	249.
248.	247.	246.	245.	244.	243.	242.	241.	241.	240.
239.	238.	238.	237.	237.	236.	236.	235.	235.	234.

STAGE

572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0
572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0
572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0
572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0

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572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0
572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0
572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0	572.0

```
                                                            STAGE
          572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0
          572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0
          572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0

          572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0
          572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0
          572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0
          572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0
          572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0     572.0
          572.0     572.0     572.0     572.0     572.1     572.1     572.1     572.1     572.1     572.1
          572.1     572.1     572.1     572.1     572.1     572.2     572.2     572.2     572.2     572.2
          572.2     572.3     572.3     572.4     572.5     572.6     572.7     572.8     572.9     573.1
          573.3     573.5     573.7     573.5     573.9     573.9     573.8     573.8     573.8     573.8
          573.7     573.7     573.6     573.6     573.5     573.5     573.4     573.4     573.4     573.3
          573.3     573.3     573.2     573.2     573.2     573.2     573.1     573.1     573.1     573.1

  PEAK OUTFLOW IS       143. AT TIME  41.67 HOURS

                                    PEAK    6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
                             CFS    143.       79.       28.       14.          2030.
                             CMS      4.        2.        1.        0.            57.
                          INCHES              2.84      4.00      4.04          4.04
                              MM             72.02    101.51    102.51        102.51
                           AC-FT               39.       55.       56.           56.
                       THOUS CU M              48.       68.       69.           69.


          **********          **********          **********          **********          **********

                                              HYDROGRAPH ROUTING

                         3 CHANNEL ROUTE TO STATION 7+00
                                ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                                    3       1       0       0       0       0       1       0       0
                                                     ROUTING DATA
                         QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                           0.0   0.000    0.00       1       1       0       0               0

                                NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                                    1       0       0   0.000   0.000   0.000      0.       0


  NORMAL DEPTH CHANNEL ROUTING
  ----------------------------

          QN(1)   QN(2)   QN(3)   ELNVT   ELMAX   RLNTH     SEL
          .0350   .0350   .0350   476.0   500.0    700.  .08600

          CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
              0.00  500.00   30.00  490.00   60.00  480.00   72.00  476.00   80.00  476.00
            100.00  480.00  120.00  490.00  170.00  500.00

  STORAGE         0.00       .26       .74      1.41      2.26      3.25      4.36      5.60      6.96      8.46
                 10.08     11.84     13.75     15.87     18.19     20.72     23.45     26.39     29.53     32.88

                                                                                    Sheet 17 of 24

  OUTFLOW         0.00    191.07    776.04   1871.51   3892.90   6684.99  10228.09  14560.86  19722.81  25753.83
              32673.81  40522.41  49204.75  59032.24  70134.11  82581.95  96446.30 111798.25 128708.21 147245.45
```

```
                                                          [illegible]  [illegible]  72.00  479.00   90.00  476.00
         100.00  480.00  470.00  490.00  470.00  500.00

   TOPA[illegible]  [illegible]    .46   [illegible]  [illegible]   2.26    3.25    4.34    5.60    6.96    8.46
        10.00   11.34   13.73   15.87   18.19   20.72   23.45   26.39   29.53   32.88


   OUTFLOW     0.00    191.07    776.04   1871.51   3892.99   6684.99  10228.09  14560.86  19722.81  25753.83
           32895.81  40582.41  49209.75  59032.24  70134.11  82581.95  96446.30 111798.25 128708.21 147245.45

   STAGE     476.00    477.26    478.53    479.79    481.05    482.32    483.58    484.84    486.11    487.37
             488.63    489.89    491.16    492.42    493.68    494.95    496.21    497.47    498.74    500.00

   FLOW        0.00    191.07    776.04   1871.51   3892.99   6684.99  10228.09  14560.86  19722.81  25753.83
           32893.81  40582.41  49209.75  59032.24  70134.11  82581.95  96446.30 111798.25 128708.21 147245.45

                              STATION      3, PLAN 1, RTIO 1

                                           OUTFLOW
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      1.      1.      1.      1.      1.      1.      1.
         2.      2.      2.      2.      2.      3.      3.      3.      3.      3.
         3.      3.      3.      3.      3.      3.      3.      2.      2.      2.
         2.      2.      2.      2.      2.      2.      2.      2.      2.      2.
         2.      3.      3.      3.      3.      3.      3.      3.      3.      3.
         3.      3.      3.      4.      4.      5.      6.      7.      7.      8.
         9.     10.     11.     11.     12.     13.     13.     14.     15.     16.
        18.     25.     40.     58.    119.    291.    370.    404.    491.    650.
       851.    921.    851.    724.    624.    542.    478.    405.    328.    242.
       175.    128.    103.     93.     89.     84.     80.     77.     75.     72.
        70.     70.     69.     68.     67.     66.     65.     64.     62.     61.

                                           STOR
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      1.      1.
         1.      1.      1.      1.      1.      1.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
         0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

                                           STAGE
       476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0
       476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0
       476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0
       476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0
       476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0
       476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0
       476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0
       476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0
       476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0
       476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.0   476.1
       476.1   476.1   476.1   476.1   476.1   476.1   476.1   476.1   476.1   476.1
       476.1   476.2   476.3   476.4   476.8   477.5   477.6   477.7   477.9   478.3
       478.5   478.7   478.6   478.4   478.2   478.0   477.9   477.7   477.6   477.4
       477.2   476.8   476.7   476.6   476.6   476.6   476.5   476.5   476.5   476.5

                                                                           Sheet 15 of 24

       476.5   476.5   476.5   476.5   476.4   476.4   476.4   476.4   476.4   476.4

                           PEAK    6-HOUR    24-HOUR    72-HOUR    TOTAL VOLUME
```

```
      476.0     476.0     477.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
      476.[illegible]     476.0     476.0     476.0     476.0     476.[illegible]     476.[illegible]     47[illegible]     [illegible]     [illegible]
      [illegible]     [illegible]     [illegible]     476.1     476.      476       47[illegible]     [illegible]     [illegible]     4[illegible].1
      [illegible].1     476.2     476.3     476.4     476.8     477.5     477.6     477.7     477.9     478.3
      478.6     478.7     478.6     478.4     478.2     478.0     477.9     477.7     477.6     477.4
      477.2     476.8     476.7     476.6     476.6     476.6     476.5     476.5     476.5     476.5


      476.5     476.5     476.5     476.5     476.4     476.4     476.4     476.4     476.4     476.4

                                PEAK    6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
                       CFS       921.      477.      142.       69.       10327.
                       CMS        26.       14.        4.        2.         292.
                    INCHES                17.07     20.37     20.53        20.53
                        MM               433.52    517.41    521.39       521.39
                     AC-FT                 237.      282.      284.         284.
                  THOUS CU M               292.      348.      351.         351.

                                  MAXIMUM STORAGE =        1.

  MAXIMUM STAGE IS     478.7

                                  STATION       3, PLAN 1, RTIO 2
                                                 OUTFLOW
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        1.        1.        1.        1.
         1.        1.        2.        2.        2.        2.        2.        2.        2.        2.
         2.        2.        2.        2.        2.        2.        2.        2.        2.        2.
         2.        2.        2.        2.        2.        2.        2.        2.        2.        2.
         2.        2.        2.        2.        2.        2.        2.        2.        2.        2.
         2.        2.        3.        3.        3.        4.        4.        5.        6.        6.
         7.        7.        8.        8.        9.       10.       10.       11.       11.       12.
        14.       17.       20.       33.       49.       65.      156.      284.      359.      483.
       627.      691.      640.      549.      470.      411.      360.      309.      248.      187.
       137.      101.       83.       74.       71.       69.       69.       67.       67.       65.
        64.       63.       61.       60.       58.       57.       56.       54.       53.       51.

                                                  STOR
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         1.        1.        1.        1.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.

                                                  STAGE
      476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
      476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
      476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
      476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
      476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
      476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
```

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```
      476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
      476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
      476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     [illegible]     [illegible]
```

```
       476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
       476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
                                               476.0     476.0     476.0     476.0
       476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
       476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     475.9     476.0


       476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
       476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
       476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
       476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
       476.0     476.0     476.1     476.1     476.1     476.1     476.1     476.1     476.1     476.1
       476.1     476.1     476.1     476.2     476.3     476.4     477.0     477.5     477.6     477.9
       478.2     478.3     478.2     478.0     477.9     477.7     477.6     477.5     477.4     477.2
       476.9     476.7     476.5     476.5     476.5     476.5     476.5     476.4     476.4     476.4
       476.4     476.4     476.4     476.4     476.4     476.4     476.4     476.4     476.3     476.3

                         PEAK    6-HOUR    24-HOUR    72-HOUR    TOTAL VOLUME
                 CFS     691.      342.       104.        50.           7541.
                 CMS      20.       10.         3.         1.            214.
              INCHES              12.25      14.87      14.99           14.99
                  MM             311.18     377.76     380.74          380.74
               AC-FT               170.       206.       208.            208.
           THOUS CU M              209.       254.       255.            256.


                                 MAXIMUM STORAGE =          1.

 MAXIMUM STAGE IS      478.3

                                 STATION       3, PLAN 1, RTIO 3

                                              OUTFLOW
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        1.        1.
          1.        1.        1.        1.        1.        1.        1.        1.        1.        1.
          1.        1.        1.        1.        1.        1.        1.        1.        1.        1.
          1.        1.        1.        1.        1.        1.        1.        1.        1.        1.
          1.        1.        1.        1.        1.        1.        1.        1.        1.        2.
          2.        2.        2.        2.        2.        3.        3.        3.        4.        4.
          5.        5.        5.        6.        6.        6.        7.        7.        7.        8.
          9.       11.       14.       17.       20.       30.       43.       57.       72.      239.
        405.      450.      435.      365.      325.      275.      245.      205.      173.      129.
        100.       75.       70.       66.       66.       63.       62.       59.       58.       55.
         54.       52.       50.       49.       47.       45.       44.       42.       41.       39.

                                               STOR
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
          0.        0.        0.        0.        0.        0.        0.        0.        0.        0.

                                              STAGE
       476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
```

Station Four

```
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.

                                                     STAGE
      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0
      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0
      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0
      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0
      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0
      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0
      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0
      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0
      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0
      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0
      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.0      476.1
      476.1      476.1      476.1      476.1      476.1      476.2      476.3      476.4      476.5      477.4
      477.7      477.8      477.7      477.6      477.5      477.4      477.4      477.3      477.1      476.9
      476.7      476.5      476.5      476.5      476.4      476.4      476.4      476.4      476.4      476.4
      476.4      476.3      476.3      476.3      476.3      476.3      476.3      476.3      476.3      476.3

                            PEAK    6-HOUR    24-HOUR    72-HOUR   TOTAL VOLUME
                   CFS      450.      209.        66.        32.        4779.
                   CMS       13.        6.         2.         1.         135.
                INCHES                7.46       9.42       9.50         9.50
                    MM              189.55     239.30     241.29       241.29
                 AC-FT                103.       131.       132.         132.
             THOUS CU M               128.       161.       162.         162.

                                 MAXIMUM STORAGE =          0.

   MAXIMUM STAGE IS      477.8

                                  STATION        3, PLAN 1, RTIO 4

                                                   OUTFLOW
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         1.         1.         1.         1.         1.         1.         1.         1.
          1.         1.         1.         1.         1.         1.         1.         1.         1.         1.
          1.         1.         1.         1.         1.         1.         1.         1.         1.         1.
          1.         1.         1.         1.         1.         1.         1.         1.         1.         1.
          1.         1.         1.         1.         1.         1.         1.         2.         2.         2.
          2.         2.         3.         3.         3.         3.         3.         4.         4.         4.
          5.         6.         7.         8.        10.        12.        14.        16.        19.        26.
         41.        56.        68.       112.       144.       132.       126.       109.        92.        75.
         67.        66.        62.        59.        56.        53.        51.        48.        46.        43.
         41.        39.        37.        35.        34.        32.        31.        29.        28.        27.

                                                     STOR
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.

          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
```

Sheet 4 of 24

```
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.

     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.

                                             STAGE
   476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
   476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
   476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
   476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
   476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
   476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
   476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
   476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
   476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
   476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
   476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0     476.0
   476.0     476.0     476.0     476.1     476.1     476.1     476.1     476.1     476.1     476.2
   476.3     476.4     476.4     476.7     477.0     476.9     476.8     476.7     476.6     476.5
   476.5     476.4     476.4     476.4     476.4     [illegible]     476.3     476.3     476.3     476.3
   476.3     476.3     476.2     476.2     476.2     476.2     476.2     476.2     476.2     476.2

                             PEAK    6-HOUR    24-HOUR    72-HOUR    TOTAL VOLUME
                     CFS     144.       79.        28.        14.           2027.
                     CMS       4.        2.         1.         0.             57.
                  INCHES               2.84       3.99       4.03            4.03
                      MM              72.01     101.44     102.44          102.44
                   AC-FT                39.        55.        56.             56.
             THOUS CU M                 48.        68.        69.             69.

                                   MAXIMUM STORAGE =          0.

MAXIMUM STAGE IS      477.0

          **********          **********          **********          **********          **********
```

Sheet 22 of 24

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS			
				RATIO 1 1.00	RATIO 2 .75	RATIO 3 .50	RATIO 4 .25
HYDROGRAPH AT	1	.26	1	922.	692.	461.	231.
		(.67)		(26.1[illegible])(	19.59)(	13.04)(	6.53)(
ROUTED TO	2	.26	1	921.	690.	416.	143.
		(.67)		(26.13)(	19.53)(	12.91)(	4.06)(
ROUTED TO	3	.26	1	921.	691.	450.	144.
		(.67)		(26.09)(	19.55)(	12.73)(	4.08)(

Dec 23 of 31

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	572.00	572.00	573.75
STORAGE	240.	240.	249.
[illegible]	0.	0.	70.

RATIO OF SPF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.	[illegible]	.42	263.	23.	8.67	40.67	0.00
.75	574.03	.28	254.	20.	6.33	40.67	0.00
.5	[illegible]	.26	247.	17.	4.67	40.67	0.00
.25	[illegible]	.09	229.	8.	2.33	41.67	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	924.	478.7	40.67
.75	694.	478.3	40.67
.50	459.	477.8	40.67
.25	244.	477.0	41.67

[illegible]

FLOOD HYDROGRAPH PACKAGE (HEC-1)

STABILITY ANALYSIS

APPENDIX E

TAMS

Job No. [illegible]
Project [illegible]
Subject [illegible]

Sheet 1 of 6
Date 6-22-81
By [illegible]
Ch'k. by

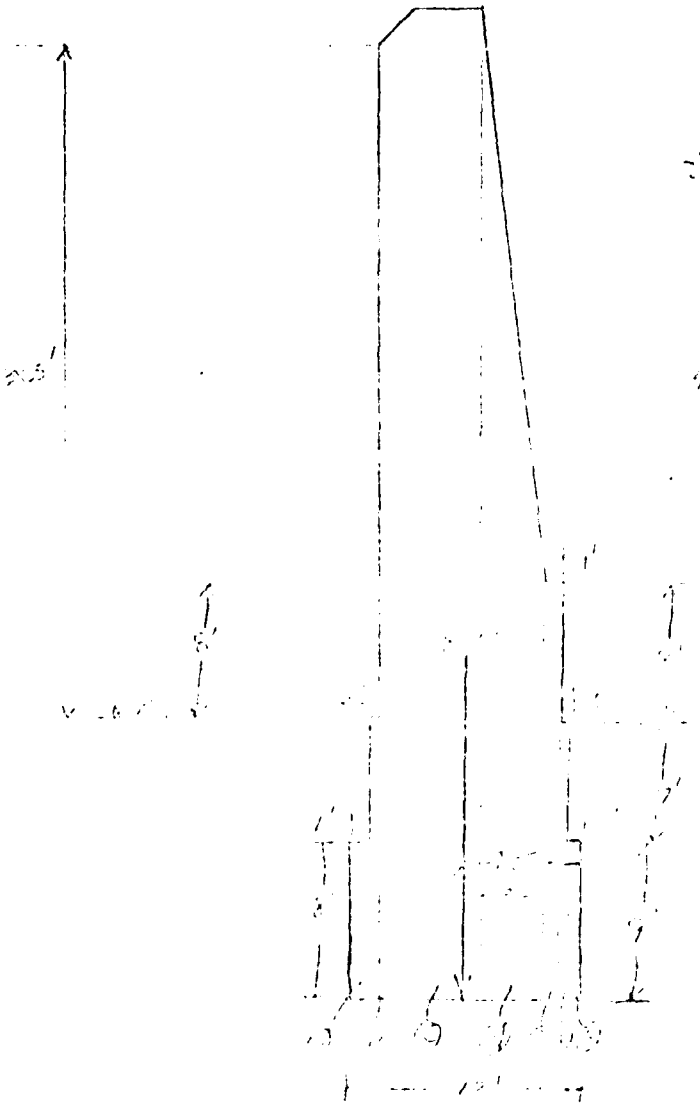
TAMS

Job No. 578-39 Sheet 2 of 6

Project Claim Lake Dam #2 Date 6-25-81

Subject Earth Pressure By DMW

Ch'k. by



1. Assume average density for sandy silt fill and cobble drainage layer is 125 pcf

2) Use at-rest coefficient of earth pressure

3) $\gamma = 125$ pcf $= 0.125$ kcf

4) $K_o = 1.0$ $k_p = 3.0$

TAMS

Job No. [illegible]
Project [illegible]
Subject [illegible]

Sheet 3 of 6
Date [illegible]
By [illegible]
Ch'k. by

Calculation of Weights of Dam Sections/ft

SECTION ③ $1 \times 9 \times .160 = 1.44$ Kips Wt of segment to D.S. toe 12.5'

④ $.5 \times 16 \times .160 = 1.28$ Kips " " " " 11.75'

⑤ $[(6 \times 50) - \frac{1}{2}(2^2)] \cdot 160 = 52.44$ Kips " " " " 8.5'

⑥ $\left(\frac{1}{2} \times 3 \times 2 + 5 \times 3\right) \cdot 150 = 19.2$ Kips " " " " 4.2'

⑦ $3 \times 1 \times .150 = 3.84$ Kips " " " " 2.0'

⑧ [illegible] " " " " 1.75'

⑨ [illegible] " " " " [illegible]'

$\Sigma F = 71.96$ Kips

$\Sigma M = [illegible]$

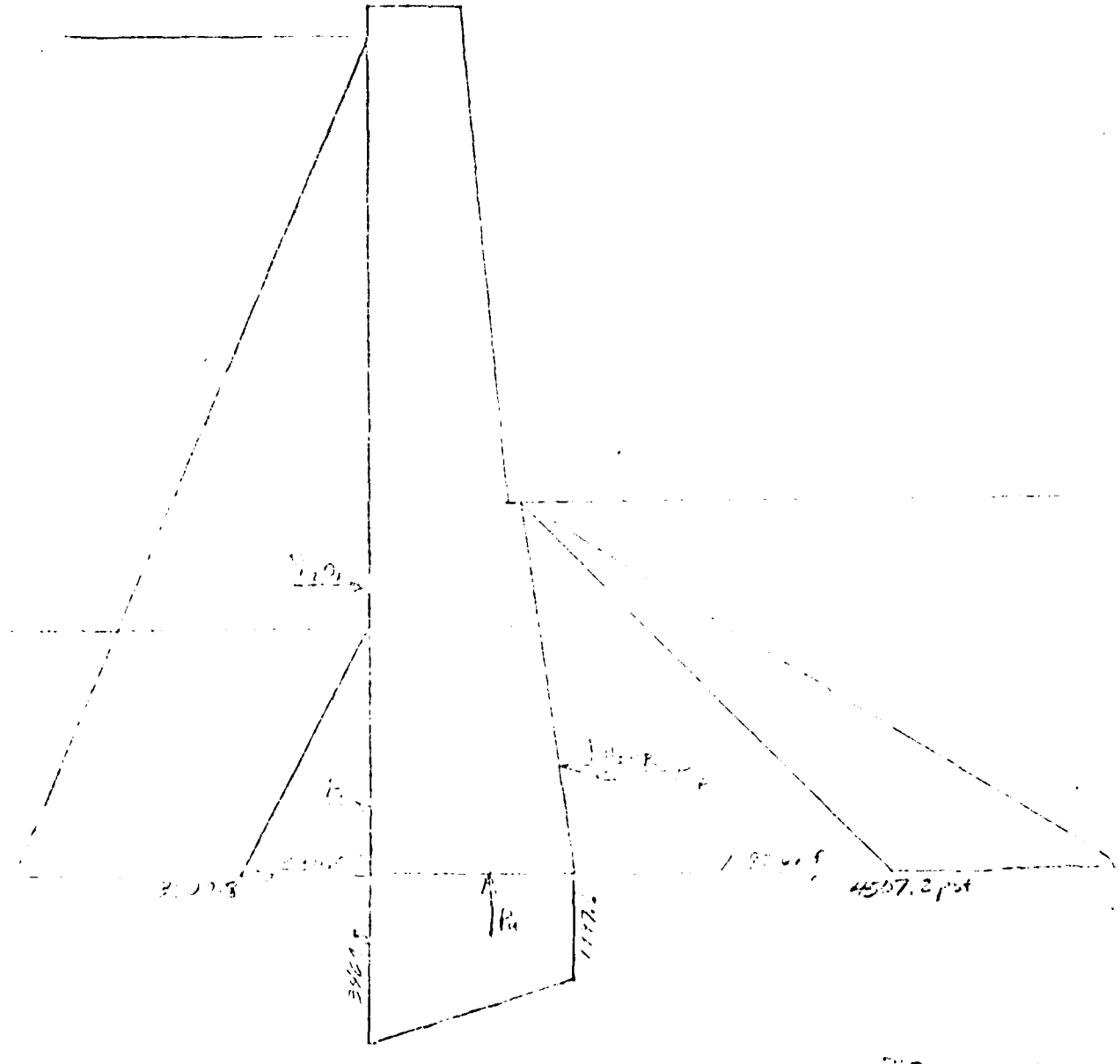
[illegible]

TAMS

Job No. 1572.09
Project Arundel Dam No. 3
Subject Earthquake Analysis

Sheet 4 of 6
Date 6/22/81
By GFM
Ch'k. by

Determine Driving Forcing Function Forces



1) $P_{1.0_L} = 5745 \times 62.4 \times \frac{1}{2} \times 5.45 = 92.67$ kips $M_{1.0} = \frac{18.5}{3} = 18.17'$

2) $P_{0.2} = 10 \times 5.45 \times 62.4 \times \frac{1}{2} = 2.644$ kips $M_{0.2} = \frac{5.45}{2} = 5.33'$

3) $P_R = \frac{3400 \times 10^{-6} \times 32.2}{2} \times 13 = 31.841$ lbs $M_R = 7.75'$

TAMS

Job No. 1579-09 | Sheet 5 of 6
Project [illegible] | Date 6-25-81
Subject [illegible] Analysis | By JFW
Ch'k. by

4) $P_{E_f} = (62.4)(24)(3) \times \frac{24}{2} = 54.09$ Kips $\qquad M_A = \frac{24}{3} = 8'$

5) $P_{H_2O_E} = (62.4 \times 24)\frac{24}{2} = 17.97$ Kips $\qquad M_A = 8'$

ΣM driving $= (92.47)(18.17) + ([illegible])(5.33) + (31.84)(7.75)$
$= 1944.6$ k-ft

ΣM [illegible] $= ([illegible])([illegible]) - 54.09)(8) + (17.97)(3) = 1154.02$

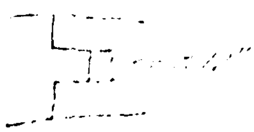
$M_R - M_D = 1154.02 - 1944.6 = -790.58$

$\bar{x} = \frac{12}{2} - \frac{-790.58}{[illegible]} = 7.5 + 15.78 = 23.28'$

[illegible]

[illegible]

[illegible] of [illegible]



Total [illegible] for 1' × 56' [illegible] = 532 k

[illegible] 1000 kip
[illegible] = $\frac{1000 \times [illegible]}{[illegible]}$ = 7.09

[illegible]
[illegible]
[illegible] 133 [illegible]

TAMS

Job No. 1529-09 Sheet 6 of 6

Project Riverdale Dam No. 3 Date 6-25-81

Subject Sounding Analysis By JSG

Ch'k. by

Including Side Shear Resistance

$\Sigma M_{driving} = 1994.6$ k-ft

$\Sigma M_{resisting} = 1154.02 + 198.16 = 1352.6$ k-ft

Still Exceeds Driving Moment

Check Slide

$\Sigma T_d = 81.92 - 31.84 = 50.08$ k

$\Sigma T_R = 92.67 + 31.84 - 8.40 - 1.37 - 7.80 = 106.94$ k

Min. Req'd Safety Factor

F.S. Sliding $= \frac{106.94}{50.08} = 2.14$

$= \frac{2.14}{0.8} = 2.66 > 1.5$

$\therefore$ All Fails OK

Check II-II with Full Resistance Due to Downstream Key and Sloping Section

TAMS

Job No. 1522-02 Sheet 1 of 2

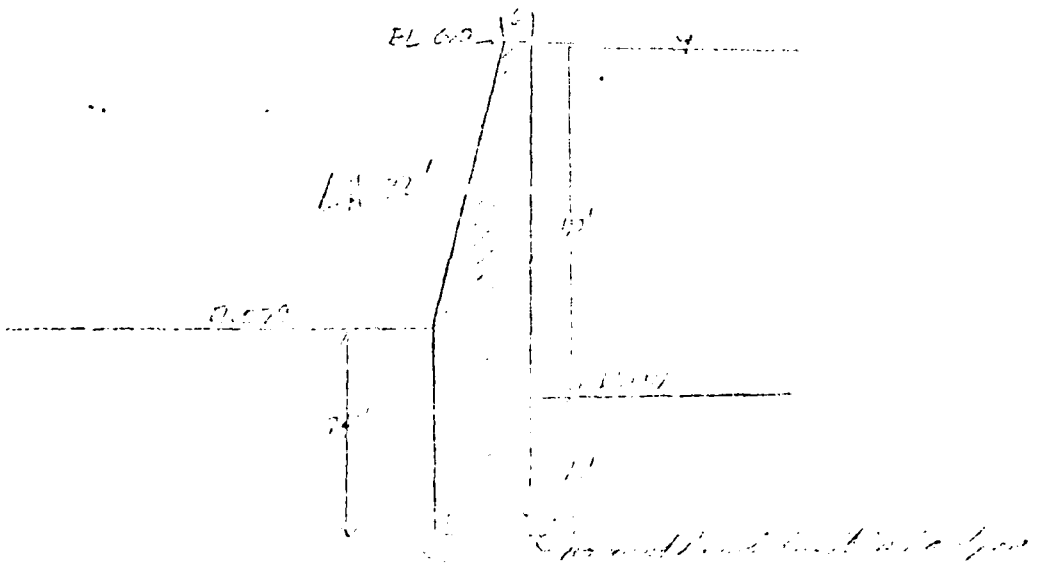
Project [illegible] Date 6-2-81

Subject [illegible] By [illegible]

Ch'k. by

Assumptions

1) Control Dam Sections - Simplified



2) [illegible]

3) [illegible]

TAMS

Job No. 211-09
Project [illegible]
Subject
Sheet 2 of 3
Date 6-2-21
By [illegible]
Ch'k. by

Analysis

[illegible]

$\frac{e}{L} = \frac{2.2}{3.5} = .603$ FS = 1.65 not adequate

[illegible]

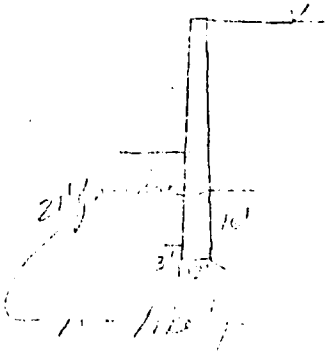
$\frac{2.2}{11} = .4$

FS = 2.1

[illegible]

[illegible]

$\frac{11}{L} = 1 \Rightarrow L = 32'$



[illegible]

REFERENCES

APPENDIX F

REFERENCES

1. "Flood Hydrograph Package (HEC-1) Users Manual for Dam Safety Investigations", U. S. Army Corps of Engineers, Hydrologic Engineering Center, September 1979.

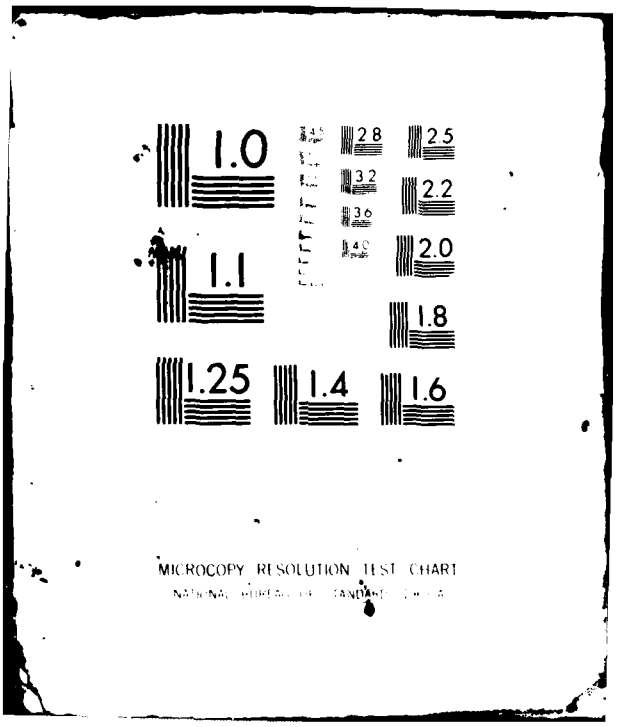
2. "Seasonal Variation of the Probable Maximum Precipitation, East of the 105th Meridian for Areas from 10 to 1,000 Square Miles, and Durations of 6, 12, 24 and 48 Hours", Hydrometeorological Report No. 33. Weather Bureau, U.S. Department of Commerce, April 1956.

3. "Recommended Guidelines for Safety Inspection of Dams", Department of the Army, Office of the Chief of Engineers, Appendix D.

4. The University of the State of New York, The State Education Department State Museum and Science Service Geological Survey - MAP and Chart Series No. 5, Geologic MAP of New York 1961, Lower Hudson Sheet.

AD-A107 406 TIPPETTS-ABBETT-MCCARTHY-STRATTON NEW YORK F/G 13/13
NATIONAL DAM SAFETY PROGRAM. NORTH LAKE DAM NUMBER 3 (INVENTORY--ETC(U)
AUG 81 E O'BRIEN DACW51-81-C-0008
UNCLASSIFIED NL

END
DATE FILMED
12 81
DTIC


1.0
1.1
1.25
1.4
1.6
2.8
3.2
3.6
2.5
2.2
2.0
1.8
MICROCOPY RESOLUTION TEST CHART

OTHER DATA

APPENDIX G

DEPARTMENT OF THE ARMY
S ARMY ENGINEER DISTRICT, NEW YORK
26 FEDERAL PLAZA
NEW YORK, NEW YORK 10007

NANEN-F

1 May 1978

Mr. Pat J. Bresha, Deputy Supervisor
Town of North Castle
15 Bedford Road
Armonk, New York 10504

Dear Mr. Bresha:

Reference is made to your letter dated 21 January 1978 and subsequent conversations with Mr. John Diogneardi of my staff concerning the North Lake Dam in the Town of North Castle and your request for an inspection and evaluation of this structure. On 10 April 1978 members of my staff met with Mr. Donald Jack, Town Engineer for the Town of North Castle and Mr. Ray Johnson, Building Inspector, Town of North Castle concerning this inspection.

The dam, approximately 40 years old is a combination arched and gravity stone-faced concrete section approximately 55 feet high (+) and 6 feet wide at the top. The middle third arched portion contains a 10 foot wide uncontrolled spillway discharging into a discharge chamber from which the water is piped under a roadway to a point where the flow surfaces and continues downstream. The developed thrust on the dam is taken by abutments at either end of the arched section. The dam is tied into high ground at either end by the cantilevered wall sections. Existing plans indicate the dam is anchored into bedrock or hardpan for a minimum penetration of 1.0 foot. One 12 inch diameter controlled outlet pipe extends through the dam at its base.

Visual observations revealed the dam to be structurally sound and free from extensive cracks. However, seepage stains were observed on the downstream face through the masonry mortar joints on the right side approximately half-way up the dam. This has resulted in the seeping water down this face collecting at the toe of the dam and flowing by gravity to the topographically lowest point of the dam in the vicinity of the spillway discharge chamber. This seepage is considered minimal and is estimated at less than one gal/min. A small housing development is located immediately downstream of the dam.

NAN...-F 1 May 1978
Mr. Pat J. Beesha, Deputy Supervisor

A review of the owners' records indicates that a similar seepage problem occurred approximately 10 years ago and was treated with grout and sealed on the upstream face. The seepage in this case occurred at the top of the dam. This recently observed seepage is not considered dangerous to the structure at this time but should be corrected at the owners' earliest convenience. As the location of the seepage is sufficiently below the top of the dam to preclude utilizing the same method of grouting as previously used, it is recommended that treatment be applied instead to the downstream face. A cementitious, capillary waterproofing material should be employed to seal the mortar joints, similar to the product made available by Vandex Inc. of Stamford, Connecticut.

If we can be of any further assistance in this matter please do not hesitate to contact us.

Sincerely yours,

J.A. WEISS
Chief, Engineering Division

INTERIM REPORT

NORTH LAKE ASSOCIATION
ARMONK, NEW YORK

DAM INSPECTION
File No. 71-145

June 11, 1971

Visual inspection by Chas. H. Sells, Inc., June 10 and 11, 1971.

DESCRIPTION

Located at the southeast end of North Lake, Windmill Farms, Armonk, New York.

A concrete, stone masonry-faced dam, approximately 500 feet in length, 35-40 feet (maximum) in height. Outward curving, in alignment, with two large formed buttresses and a center-located spillway.

There is a pipe at the foot of the dam, controlled by a wheel-operated gate valve, to permit drainage of the lake. At the outflow of the pipe, there is a formed areaway to receive water from the spillway (and/or the pipe) to prevent erosion at the base of the dam.

The dam is apparently anchored to the ledge rock evident at each end of it.

At the base of the dam, Windmill Road runs transversely across the face and perimeter of the dam, with a pipe culvert passing beneath the road from the base of the spillway to the natural stream bed, continuing to Long Pond to the southeast.

CONDITIONS EXISTENT

There is no evidence of any settlements, heaving, deflections or lateral movement of either the concrete structure, the adjacent rock ledges or the earth in the vicinity of the top or bottom of the dam.

Very minor cracking of the concrete, or separation of the stone facing is evident. Most minor cracking has been caulked in the past, as, similarly, minor repointing of the stone masonry is visible, demonstrating an active maintenance program as required.

The only wearing of concrete, (and very minor), is just below the crown of the dam, on the lake side, at high water, probably caused from some ice action. This condition is almost completely confined to the lake side of the dam at the narrow end of the lake toward the westerly end of the dam. All other concrete surfaces are weathered, apparently originally placed concrete, in sound, smooth condition.

There is no evidence of active leakage. There are possibly a half-dozen "wet" or damp areas, relatively small in size, with no visible moisture movement, and localized and minimal in extent, as evinced by no tracings of water to the base or away from the dam.

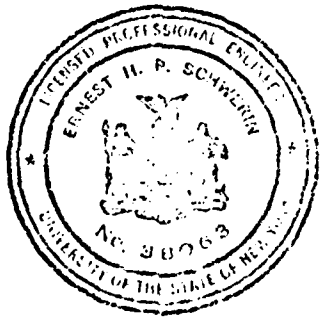
As stated, there is no evidence of erosion of earth slopes at the dam or the road at the spillway area, nor is there any evident exposure of foundation caused by prior erosions.

CONCLUSION

From the preliminary visual inspection, the dam appears to be in sound, stable condition. Except for minor caulking required, and cleaning out of the areaway of the spillway at the base of the dam, there is no recommendation for corrective action required.

The action of the gate valve was not inspected. However, the mechanism at the top of the dam appears in operable order.

It is recommended that the Final Report may only be prepared upon the availability of construction plans and other data.



Respectfully submitted,

CHAS. H. SELLS, INC.

By _____

Ernest H. P. Schwerin, P. E.

EHPS:ns

April 17, 1964

Mr. Raymond Johnson, Building Inspector
Town Hall
Armonk, New York

Dam - North Lake
Windmill Farms

Dear Mr. Johnson:

Pursuant to your request, I have reviewed the condition of the dam at North Lake, Windmill Farms, with respect to a wet area observed on the face near the westerly circular abutment and about ten feet below the lake water level.

First of all, it was necessary to investigate the initial stability designed in the structure. The section and dimensions used in an analysis were based on the original drawings which were loaned to you by the owners and on field measurement which indicate that several changes were made in the design during construction.

The check analysis was based on a condition where the dam acts as a single arch with fixed ends, and on the assumption that the entire cross section, including the stone facing on the downstream side, was an integral part of the arch. On this basis, the maximum and minimum stresses appear to be of the proper range for dams of this type with the maximum on the compression side 520 PSI, and on the opposite side 20 PSI, still in compression.

The seepage through the dam occurs in the vicinity of the vertical joint near the west abutment. There are indications that the mortar joints between some of the stones in the area are deteriorating. The leak, therefore, must not be ignored and could be of serious concern in the future if a further weakening of the joints should occur. Computations indicate that without the stone facing, the compressive stresses will increase about 30%, and that tensile stresses might develop.

It is recommended that the owners be urged to investigate the cause of the leak in the near future. The plans indicate that the joint is sealed by copper flashing which may have failed. The initial step might be to drop the water

level gradually and observe its relation to the leak. There is also a possibility that cracks may have occurred near the joint, thus allowing the water to seep through the structure. Appropriate sealers are available for either situation.

In conclusion, it is my opinion that the leak should be remedied before another winter season.

Yours very truly,

Ralph L. MacDonald

CHAS. H. SELLS
INC.

CHAS. H. SELLS
GEORGE R. SMITH
L. DUNCAN OLMSTED, JR.
OWEN M. QUINN, JR.
ALBERT J. RAMAN
JAMES R. SELLS
BRUCE G. SMITH
ERNEST SCHWERIN

ASSOCIATES
GEORGE S. BECKETT
PAUL R. SCHOFFER
ROBERT W. SUCHA
FRED W. HAETINGER
ARTHUR S. FEILE, JR.
ALEXANDER HART

CIVIL ENGINEERS & SURVEYORS
409 MANVILLE ROAD, PLEASANTVILLE, N.Y. 10570
914 769-1520

June 17, 1971

NORTH LAKE ASSOCIATION
ARMONK, NEW YORK
DAM INSPECTION - FINAL REPORT
FILE NO. 71-145

North Lake Association
Windmill Farms
Armonk, New York 10504

Attention: Mr. Ralph A. Bankes, Sr., Vice Pres.

Gentlemen:

As requested by your Association, the Final Report on the North Lake Dam is hereby forwarded.

Thank you for the opportunity of serving you in our professional capacity. Please call upon us should you again require our assistance.

Very truly yours,

CHAS. H. SELLS, INC.

By E. H. P. Schwerin
Ernest H. P. Schwerin, P.E.

EHPS:gs

Encls: Final Report (Triplicate)

FINAL REPORT

NORTH LAKE ASSOCIATION
ARMONK, NEW YORK

DAM INSPECTION
File No. 71-145

June 17, 1971

Examination of Available Data and Drawings, Final Report:

Contact was made with several agencies of the Town of North Castle and Westchester County which would have jurisdiction of construction in the area including the dam.

The construction pre-dated the law requiring County responsibility therefore, no plans of the construction are available from County sources.

Discussions with the Town Engineer (Mr. Edward Ahneman), Town of North Castle, revealed the existence of a report by an Engineer, Mr. Ralph L. MacDonald, dated April 17, 1964, prepared at the request of the Town Building Inspector. This report and accompanying sketch is on file at the North Castle Town offices.

According to his report, Mr. MacDonald prepared his sketch from original Construction Drawings loaned to the "owners" of the dam at that time (which drawings apparently are no longer available) and measurements made in the field by Mr. MacDonald.

Mr. MacDonald's report included both an initial stability design analysis, an inspection of an apparent leak in the dam and some deterioration in some mortar joints between the stones in the masonry facing of the dam.

The report indicated structural stability "within the proper range for dams of this type".

Recommendations for repair made in the report were apparently followed as there is little or no evidence, at this time, of any of the conditions described.

FINAL CONCLUSION:

The existence, in the official Town of North Castle files, of a relatively recent requested and accepted "stability" report and the visual inspection performed by this office (please refer to our "Interim Report" to the North Lake Association, dated June 11, 1971) is the basis then of our final conclusion: That the dam is satisfactorily providing the function for which it was designed, and that except for the minor corrective actions recommended in our "Interim Report", there are no futher recommendations to be made by this office.

Respectfully submitted.

CHAS. H. SELLS, INC.

By _____
Ernest H. P. Schwerin, P.E.

EHPS:gs

Encls: Drawing - Sketch of Dam